Popular Woodworking

Issue 42 April/May 1988 $2.95

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Popular Woodworking

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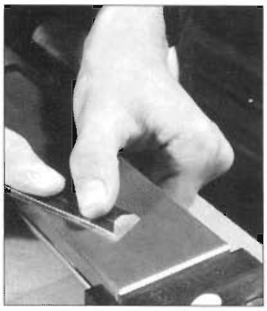

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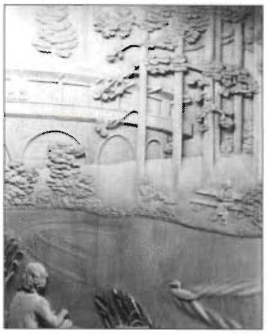

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On the Cover

If springtime turns your thoughts to gardening and woodworking, combine the two with our "Garden Cart and Potting Bench" project. Tom Crabb shows how to make this utilitarian yard accessory, complete with tilting soil bin, starting on page 26.

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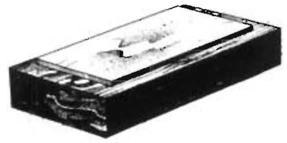

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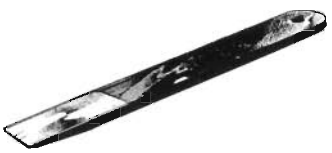

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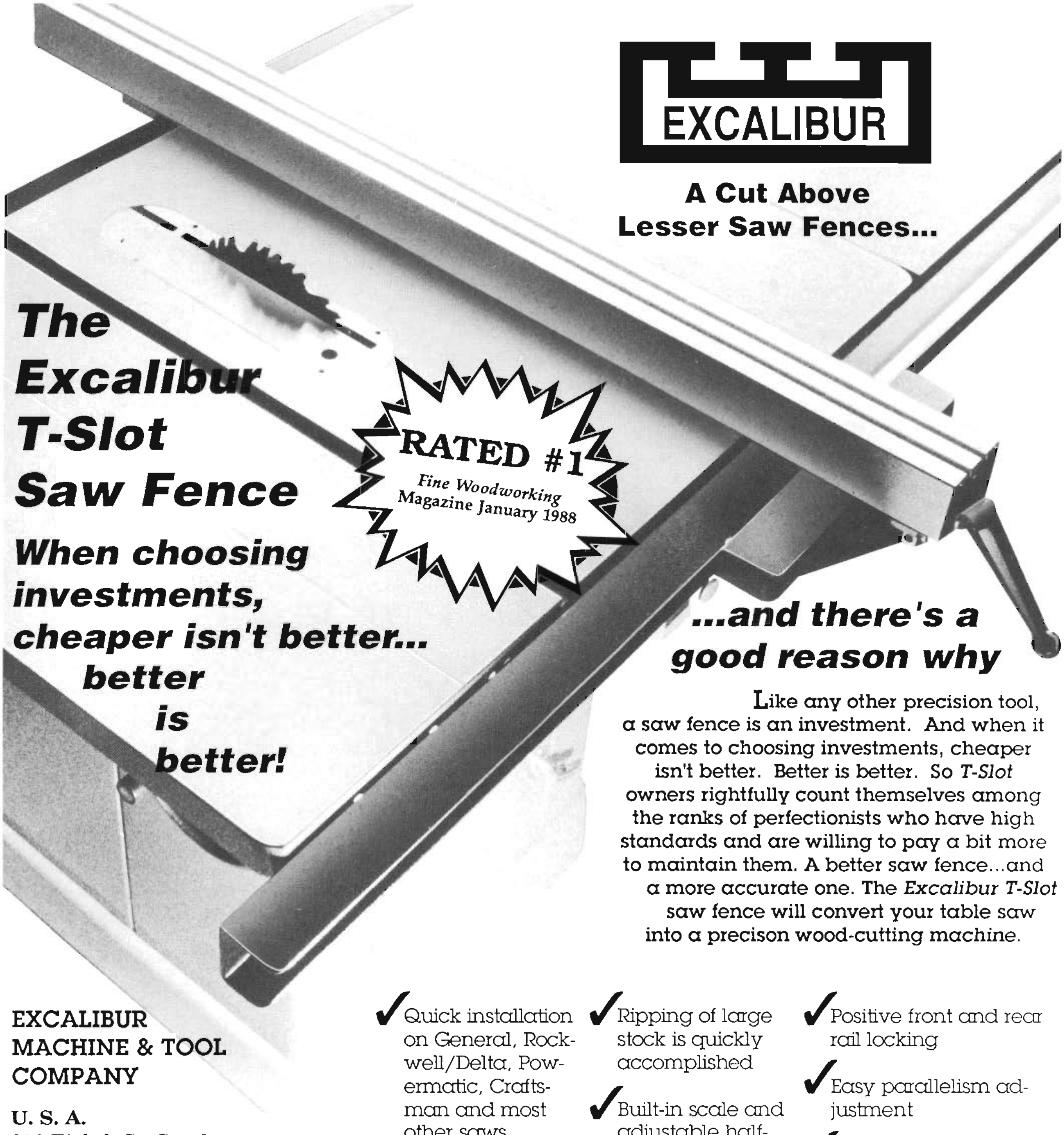

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Letters

Popular Woodworking *welcomes your comments, pro or con, about articles we publish. Send your letters to: Editor,* Popular Woodworking, *1300 Galaxy Way, Concord, CA 94520. Letters may be edited for publication.*

#95 Fan Club

Mr. Foster's enthusiasm for the Stanley #95 design plane (December/January 1988) is understandable. Ever since I bought one about 35 years ago, for a few dollars, I have used it whenever I could.

I suppose it has faults I no longer pay attention to, but requiring right-handed people to pull it, rather than push, is not one of them. I am right-handed, and have never yet had occasion to pull it.

To those considering the purchase of an edge-trimming plane, two things may fairly be said of it.

First, like all planes, the sole will almost surely need to be made flat. The built-in fence is likely to need flattening too. In addition, the two surfaces need to be brought or kept to a true 90° angle to each other. For most of us, filing is the best way to accomplish this. If you can find one, use a 12" smooth hand file. You will work more accurately if you "flat file," i.e., laying the file flat along an edge of a table or bench and drawing the sole or fence of the plane against the file teeth. Position it so the "safe" (untoothed) edge of the file rides along the inside of the plane.

This plane does not *guarantee* good results. Like any block plane, the blade must be set right: not too deep a cut, not cutting deeper on one corner of the blade than the other. And of course, the plane has to be held so the fence is always riding flat against the side of the work.

In defense of the lever-operated depth adjustment: Just remember to loosen up the blade slightly, pull the lever out with your fingers, and then set the blade depth by tapping the lever with a small plastic hammer. Then tighten up the blade again. Works like a charm.

Henry Kramer
Somerville, NJ

Thanks for Issue #40 with the article on #95 planes. I have always underestimated people's love of bronze, so we may produce a bronze version of our model. It doesn't cost that much more.

Leonard G. Lee
President, Lee Valley Tools Ltd.

More Clock Info

Here is some addenda to the "For More Information" section of John Nelson's "Clock Kits" (February/March 1988):

Armor Products (Box 445, East Northport, NY 11731) carries an extensive selection of clock plans, movements and hardware.

Also, we inadvertently listed Turncraft Clock Co. as a kit manufacturer, and gave an old address for them. Turncraft, like Armor, provides plans, movements and other clock components. Their correct address is: P.O. Box 27288, Dept. PW288, Golden Valley, MN 55427.

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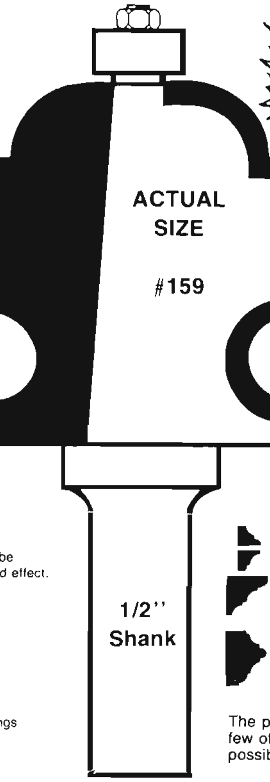

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G1247	10"	⅝"	30	Ripping	$29.95 PREPAID.
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G1249	10"	⅝"	60	Fine Finishing, Cabinet Work	$41.95 PREPAID.
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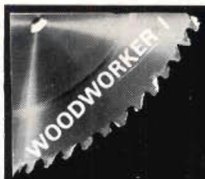

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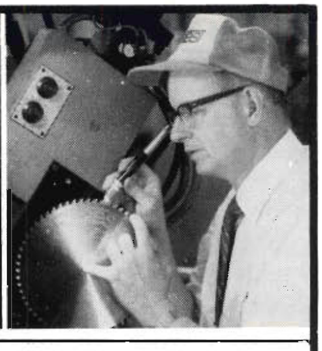

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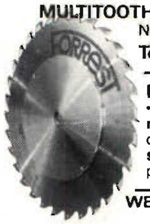

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The Woodworker's Journal

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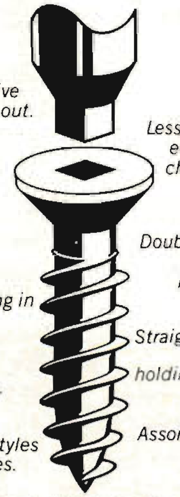

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Book Reviews

by Hugh Foster

Toolboox

The Complete Book of Portable Power Tools by R. J. De Cristoforo (Sterling Publishing Co., Inc., Two Park Avenue, New York, NY 10016, copyright 1987) 258 pages, paperback, $14.95

The author knows as well as you and I do that this book is far from the "Complete" of his title, but novice woodworkers will appreciate this collection of easy–to–read, well–illustrated material. De Cristoforo covers safe use of the common tools: the circular saw, saber saw, reciprocating saw, electric drill, router, belt sander, pad sander, disc sander/polisher, power planes, flexible shaft tools and other grinders, various battery powered tools, and some unusual tools as well. He also tells how to fabricate stationary work stations for portable tools. For those with access to a fully set–up shop (whatever that is), this won't make much difference, but then, neither will the rest of the book. For the novice, however, these set ups will help ease the transition from novice to expert tool owner.

The book also discusses lumber, panel materials, other wood products, abrasives, hardware, and shop math. These appendices consume nearly the last third of the book. While some of the coverage may seem superficial, the sections on hardware and shop math fascinated this reviewer who found himself saying, "I didn't know that" so often that "De Cristoforo's Book of Shop Math" might be a good idea.

Shaper Handbook by Eric Stephenson (Linden Publishing Co., 3845 N. Blackstone, Fresno, CA 93726, ©1986) 192 pp., paperback, $15.95

I've always been deathly afraid of shapers. In my shop a router table does what it can, and I send out the rest. Part of the reason is economic and part is a matter of room, but *fear* is the dominant feature. It's important to understand this fear as a component of my reading of Stephenson's book. The cover calls this "Essential reading for all those concerned with work on this machine." I've got to agree. Stephenson's balanced approach to the topic may not have convinced me to buy a shaper, but he has readied me to learn to operate one, and that's surely a step in the right direction.

The book was originally published in 1986 as *Spindle Moulder Handbook* by Stobart and Son, Ltd., London. You may have to get past the book's Britishness to appreciate its beauty. I've grown accustomed to the differences in vocabulary, but others may need a translator. It's worth it, though. Nowhere else will you find all this information about shapers. After a quick introduction, the book gets directly into cutterhead design and grinding. This material is presented apparently in hopes that understanding the theory of cutting heads will lead to better understanding of how to operate the machine - in terms of both results and safety. Many pages are devoted to safety considerations and jigs. Indeed, the jigs and templates collected here are adaptable to any shaper and are the high points of the book. If you have a shaper, you need this book.

Fine Tuning Your Radial Arm Saw by John Eakes (Lee Valley Tools, Ltd., Veritas, 12 River St. East, Ogdenburg, NY 13669, ©1987) 106 pp., hardcover $9.95, paperback $7.95

Let it be noted from the outset that this book is worth searching out if only for its wry, wonderfully ironic cover. Even if you don't own a radial arm saw, you'll love the cover.

The author says that it's not fair to pass up or get rid of a radial arm saw because of its reputation for sloppiness. His book is about tuning and adjusting the machine to make it every bit as accurate and safe as a table saw. Eakes describes this adjusting process in reference to three models: Rockwell (now Delta), Craftsman (still Sears), and DeWalt (now Black & Decker). Since these models make up most of the market, these manufacturers would be wise to include this book with their saws.

Eakes explains what he calls the six principles of precision: snug movement, positive clamping, use of the end part of slack, squaring to actual work surfaces, verification on cut wood, and definition of entry before cutting. The rest of the book goes on to tell how to go about achieving each of these steps on each of the tools. Eakes points out that the greatest safety combination of all is a sharp blade, a precisely lined-up saw, and a patient woodworker. This book, if you follow its advice patiently, will ensure that you have at least two of these elements.

Every user of a radial arm saw probably needs a copy of this book, for it quite simply promises an accurate cutting saw. If I had this book ten years ago, I'd surely not have sold my then "woefully inadequate" radial arm saw. Maybe it is time to hunt up a new one.

The Table Saw Book by R. J. De Cristoforo (TAB Books, Inc., Blue Ridge Summit, PA 17294, ©1988) 342 pp., paperback, $15.95

Although it looks deceptively simple, this one is likely to be the most complete book about table saws now available. The first chapter glosses over the various kinds of table saws available without really doing much to help a prospective purchaser make a decision. Though it is sometimes overly platitudinous, the second chapter is a good safety essay, especially regarding guards, eye protection, ear protection, lung protection - and attitude. The third chapter tells us what needs to be aligned in a table saw to save both time and materials, but it doesn't really do a decent job of telling us *how* to align it. The fourth chapter is about saw blades; it contains lots of technical information that we shouldn't just gloss over since it will help us better understand how the saw works.

The fifth chapter, "Crosscutting," has forty-three photos and drawings that help make the process clear. If I were half as bright as I'd like to think I am, I'd already have half the nifty jigs from this book. As you read chapter five, you understand why you bought the book. The collection of jigs and fixtures just gets bigger as De Cristoforo takes us through the next half dozen chapters about ripping, angular sawing, dado sawing, using the moulding head, practical woodworking joints, and special applications. Only the chapter about the moulding head was less than

Hugh Foster is an English-teaching woodworker in Manitowoc, Wisconsin.

convincing. While Stephenson's **Shaper Handbook** (elsewhere in this review) changed some of my anti-shaper phobias, even this excellent chapter with its jigs and safety fixtures will not lead me to use this aspect of the table saw. On the other hand, it would be awfully easy to spend the next several weeks in the shop building all the jigs in this book. De Cristoforo's advice leads to a better plan: build them slowly and accurately as you need them, use them, then store them carefully - they'll last a lifetime. So will the practical advice offered in this book.

The Workbench Book by Scott Landis (The Taunton Press, 63 South Main Street, Box 355, Newtown, CT 06470, ©1987) 248 pp., hardback, $24.95

It's hard to tell which aspect of this book to like best. On the very simplest level, it contains plans for quite a few dandy benches, but it's also an examination of living historical traditions and the people who build them. The book questions the prevalent attitude which suggests that "real" craftspeople build their own benches. Landis argues that it takes a skilled woodworker to build a bench, and since the bench is as important as any tool, it should be in the shop as we *begin* exploring the craft. Building a bench means 120+ hours of work and a couple hundred dollars' worth of lumber and hardware. Now does the price of commercial benches still look so bad?

However, we all have an urge to build our own bench sometime, and that is probably at least part of the reason this book is surely destined to become a classic. Landis tells us both how and, perhaps more importantly, why to build an 18th century Roubo bench, a 19th century Shaker bench, and a variety of benches in the European, English, and Japanese traditions. Choosing and installing vises and other hardware are covered thoroughly. So are specialized vises for boatbuilding, instrument making, and carving. The last chapter treats Black and Decker's Workmate® in a way that certainly enhanced my respect for it. Appendices offer measured drawings of the benches, sources of supply, credits, a wonderful bibliography, and an index.

Right now I can only think of one major woodworking book published in 1987 that I haven't yet seen, and this beauty, **The Workbench Book**, may well be the best of the lot. I recommend it highly. PW

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Videoscene

by Alan Marks

Dovetails with Kenneth E. Bowers, from the Punkin Hollow Video Library, Woodworking Series, © 1984 by Anderson Video Communications, P.O. Box 09465, Milwaukee, WI 53209, 80 minutes, $39.95

Kenneth Bowers is a native of North Yorkshire, England. Granted, I don't know a whole lot about them, and it may not be a universal trait of the English, but to me they project a dogged confidence about being able to cope with reality. There's something very reassuring to me in these troubled times about the quaintly complacent, faintly opinionated tone of a solid English accent.

Now certainly I realize he is just being himself, a woodworker, yet Bowers' very Britishness blows him up bigger than life for me. I judge him to be in his eighties, and he speaks with the authority old age bestows upon us whether we deserve it or not.

This video on dovetails has no remarkable graphics. No dissolves, fades, or music. Close-ups and lighting could have been better. Bowers' hand tool techniques – how can I say this without sounding presumptuous? – did not impress me. Some are time–consuming and inefficient. I don't know if that really matters; it depends upon whether one is trying to make a living at the craft or not. I used to be smug about my own dovetail technique, and I felt critical of the way others did theirs. I know now that there is room for improvement in my technique, and I believe the craftsman with the edge is the one who is flexible enough to recognize and adopt a better method when shown one.

Bowers' description and demonstration of the dovetail's strength impressed me, but I could not accept that the "proper" slope for a dovetail was one in seven. This seemed too dogmatic to me. I like to gauge things by eye. I immediately reached in my cabinet for the dovetail template I designed long ago according to what looked best to me and measured it: precisely one in seven. What can I tell you?

I must also confess that his dovetail template is a masterpiece of simplicity and functionality and mine is unnecessarily complicated in comparison.

He does the tails first, pins afterwards. I was taught to do the opposite because it's quicker and more accurate to lay out the tails according to the pre–cut pins. He marks with a pencil – I was taught to use a marking gauge or a scribe. He shows a method using a coping saw to cut out waste between pins, then he trims with a paring chisel. This seems unnecessary to me; in fact, I began to wonder if perhaps he were self–taught, or whether woodworking in England was not as refined as in Sweden where they taught me to use a chisel and cut it right the first time. Maybe they just like to fiddle around more in England.

Hand tool methods such as he demonstrates can be applied with great efficiency, but that may not necessarily be the goal.

I enjoyed this tape despite its rambling, at times boring nature, and the slowness with which Bowers presents his material. There is no attempt at previewing what will be covered and no summing up of what has already been covered. Pedagogically it receives a low mark.

The high point of the tape for me was seeing a lap dovetail joint with a mitered pin and tail on top and bottom. Unfortunately, he did not demonstrate how to make it, but it could be figured out and used for design enhancement. (Editor's note: This joint *is* explained in our Mirror Frame project on page 40.)

Mortice & Tenon; Dados with Kenneth E. Bowers, from the Punkin Hollow Video Library, Woodworking Series, © 1984 by Anderson Video Communications, P.O. Box 09465, Milwaukee, WI 53209, 56 minutes, $39.95

This is the fourth tape in the Punkin Hollow series of seven on woodworking. My criticisms of the above tape apply here as well. Kenneth Bowers is something like a comfortable old shoe, well broken in and easy on the foot. One forgives him for repeating phrases three times for emphasis or for repeated warnings, such as cautioning us to place the saw against our thumbs when starting a cut, not on it. I experienced these as endearing octogenarian habits. Perhaps someday the dignity of old age will confer upon me similar rights and privileges.

There are some nice pointers in this tape. Watching Bowers chisel out a mortise (spelled "mortice" in England) was a treat. Mine are done by machine. Seeing how the bevel on a mortising chisel can be used to break out chips intrigued me. My mortises all get done with a mortising table hung on the side of my table saw.

There was also a good reason given for letting the stiles project past the top and bottom rails on frames until after glue-up. Bowers uses the projections to knock the assembly apart while fitting, eliminating the need to use special care in hammering. After glue–up, the battered projections are simply cut off.

I have always done my dadoes either with a router or with a table saw and a dado blade. Learning to do them by hand never concerned me, but seeing Bowers do one accurately without machinery proved fascinating.

Making Mortise-and-Tenon Joints with Frank Klausz, © 1986 The Taunton Press, Box 355, Newtown, CT 06470, 60 minutes, $29.95 or $14.95 as a rental

As is often the case with its videos, this one by The Taunton Press opens to a spirited shotgun series of preview scenes set appropriately to the tune of a rousing piano concerto by the Czech composer Dvorak, one of Frank Klausz' former neighbors (Klausz comes from Hungary). This video, the music tells us, is going to be exciting.

I found it an excellent tape, though by no means as spirited as the music promises.

Whereas Kenneth Bowers used hand tools exclusively in his demonstrations, Klausz uses a combination of hand and power tools in a dazzling display of virtuosity. I might say by way of judgment that the skillful craftsman trying to make the most of time would be advised to adopt Klausz' techniques. Others will prefer Bowers' because they rely less on skill and more on technique.

You will gladly forgive Frank Klausz

***Alan Marks** is a cabinetmaker in Carmel Valley, California, and a contributing editor to PW.*

for his creative pronunciation of the English language. The sophisticated technique he presents makes such concerns petty. As before, when I reviewed tapes showing this man doing dovetails and finishing, I was amazed at his refined methods. The only time he used his folding rule (and I was shocked to see he had forsaken his native metric system for inches) was when it was absolutely unavoidable. For the rest of his work, he transfers marks directly from the pieces themselves or from a drawing. Where measurements need not be accurate, he assesses them by eye.

First he demonstrates cutting a haunched mortise and tenon joint entirely by hand – no machines. He uses the hand saw to cut shoulders, and does not tediously pare down to his line with the chisel as Kenneth Bowers does.

Because his demonstration is so tightly compressed on this video, I was not able to grasp the layout instructions at first sitting. Fortunately, there are numbers in the upper left hand corner which refer periodically to illustrations in the booklet supplied in the cassette package.

Frank's bench stop is a real winner – it's a marvel of efficiency to see him cut his table rails to length using it.

After showing this exclusively hand–made joint, Klausz shows a door frame joint using a combination of the plunge router for mortising and the band saw to cut out the tenons and to make coped joints. This is the first demonstration of a coped joint I have seen. Using the plunge router obviates the need for a mortising table for most work.

His third joint demonstration features a hollow–chisel mortiser and a table saw combination. Klausz chooses a chair frame with a combination of different mortise and tenon joints, the most complex of which is a joint with a compound angle. I like his use of a hand saw to cut the compound–angled shoulders on the tenons. I always monkey with the table saw to do these. His way saves time.

As before, when coming to the end of one of the tapes in the series featuring Frank Klausz, I always hope there will be more to come. **PW**

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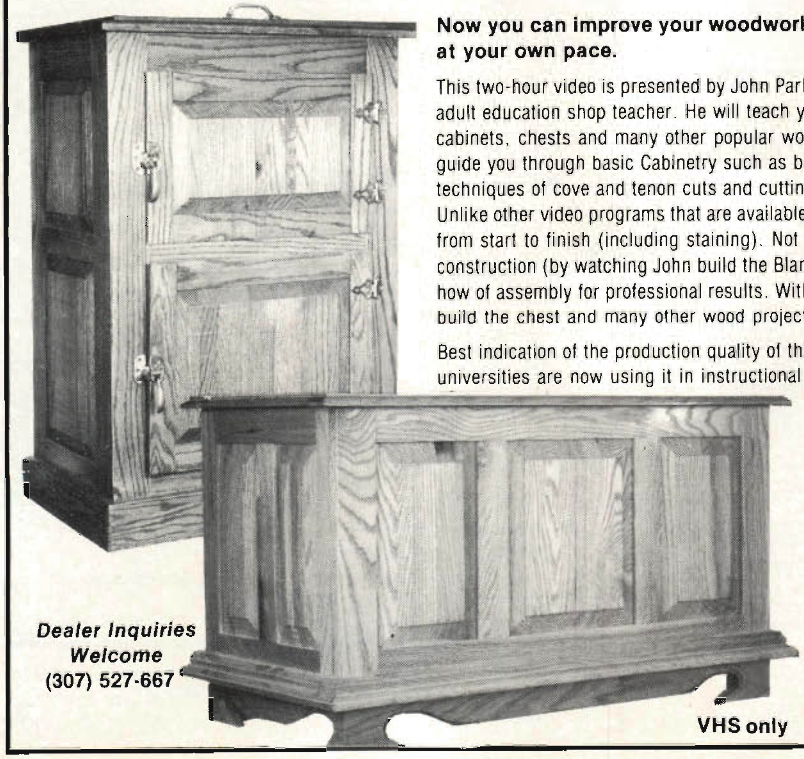
Best indication of the production quality of this tape is the fact that hundreds of high schools, vo-techs and universities are now using it in instructional settings.



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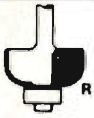		COVE				
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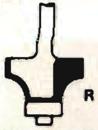		ROUND OVER				
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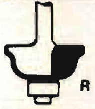		ROMAN OGEE				
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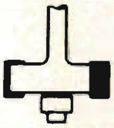	#11	3/8" RABBETING	Deep 3/8"	1¼"	1/2"	14.00
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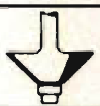
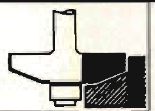
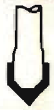
	#12	45° CHAMFER	45° Angle	1½"	5/8"	15.00
	#15	RAISED PANEL	20° Angle	1-5/8"	1/2"	25.00
	#35	1/4" V Groove 90°		1/4"	1/4"	8.00
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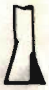	#16	3/8" Dovetail 9°		3/8"	3/8"	7.50
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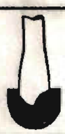		CORE BOX (ROUND NOSE)				
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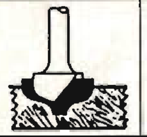		GROOVE FORMING OGEE				
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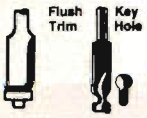 Flush Trim Key Hole	#13	1/2" FLUSH TRIM		1/2"	1"	8.50
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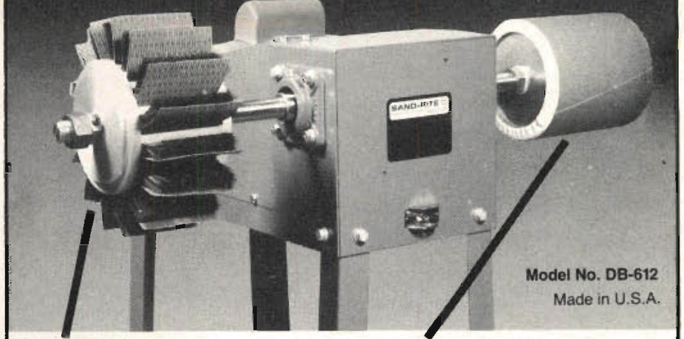

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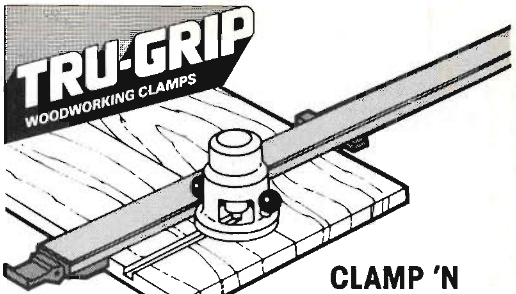

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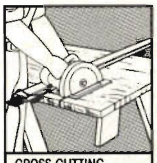
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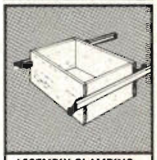
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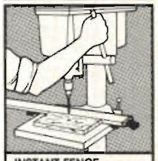
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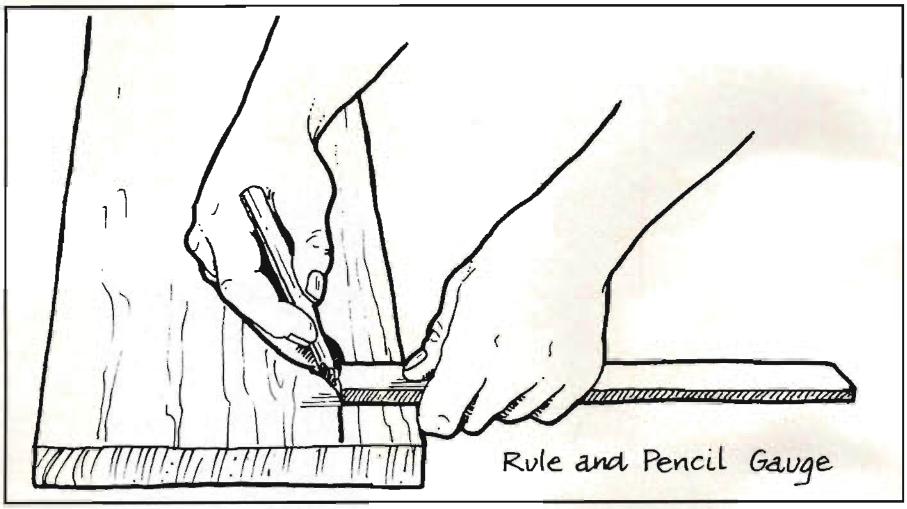
Gauges

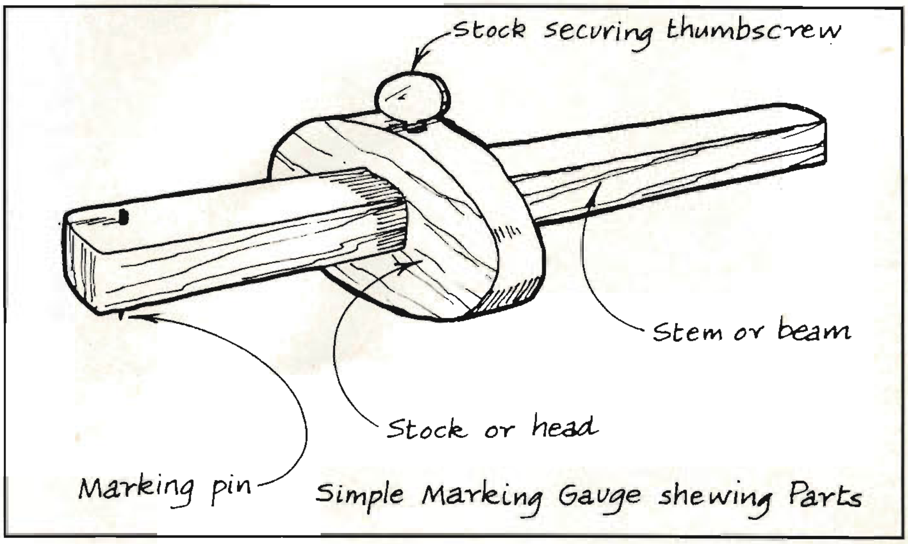


Rule and Pencil Gauge

Woodworking gauges exist in a surprising number of types and varieties. While every woodworker is surely familiar with the basic marking gauge, there are probably few today who have more than two different types in their tool boxes. This is a pity since some of the less well-known types can prove extremely useful and convenient once you are aware of their existence.

There are many tools used in woodworking that might be called gauges, but convention and usage have decreed that the term be reserved for those measuring and marking tools which conform to a particular construction, namely the stock-and-beam construction. The stock, or head as it is also called, is no more than a fence or guiding block that moves along a rod-shaped part (known as the beam or the stem) that contains some form of marking or cutting device such as a pin, pencil, or small cutting edge.

As I mentioned before, there are numerous woodworking tools which might qualify as gauges in the broadest sense, and indeed many are, in fact, known as gauges. The gauges that will be considered here may be divided into three main groups: Marking Gauges; Cutting Gauges; and Panel and Slitting Gauges.



Simple Marking Gauge shewing Parts

Apart from various Panel Gauges, these three groups all share the same basic form, so much so that the casual observer might not at once be able to discriminate between them. However, a closer examination of what "gauging" is all about will disclose niceties of difference between the several types which will translate into degrees of sophistication much appreciated by the careful worker.

Gauging Basics

Most carpenters are probably aware of the technique of drawing a line parallel to the edge of a board with a pencil while holding a couple of fingers between the pencil and the edge of the board. This is surely the simplest form of marking gauge, and for rough carpentry, usually more than adequate. A step up from this is the rule-and-pencil gauge – whereby a pencil is held at the end of a rule (or any other rigid stemlike object) and marks a line parallel to the edge of a board as the rule is drawn along it. By varying the point at which the rule is held against the board, differently spaced lines may be drawn. A closely related technique is available to many users of the contemporary metal tape measure, since many tapes are furnished with small apertures formed in the hook at the end of the tape for the same purpose as the pencil at the end of the rule. However, the simplest and most basic marking gauge constitutes a quantum leap forward from either of these techniques in terms of ease and exactness. For one thing, the required measurement may be locked into place, freeing your hands from the necessity of maintaining their grip for as long as you need to keep the gauge at the desired measurement.

The other main advantage of using a purpose-built gauge lies in the control that may be exercised over the scribed line. It does not take much practice to be able to manipulate the gauge so the scribed line is always perfectly parallel to the edge of the work and always inscribed with the same pressure.

Two main techniques are practically all that is required for successful use of virtually any gauge. These are the necessity of keeping the stock pressed closely to the work (note that I said "closely," not "tightly" – excessive pressure does not increase accuracy but merely wears the face of the stock unnecessarily) and developing the knack of maintaining a con-

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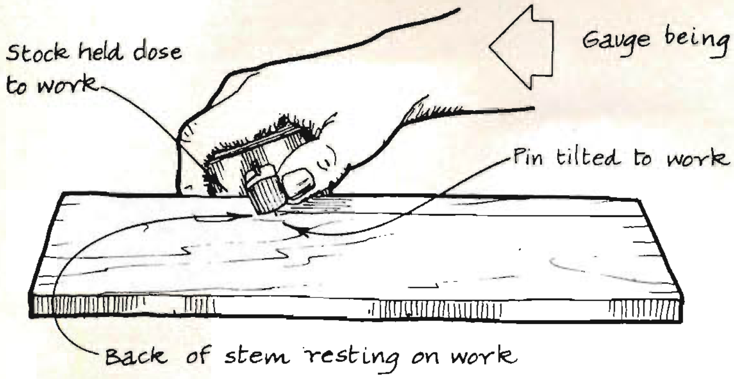
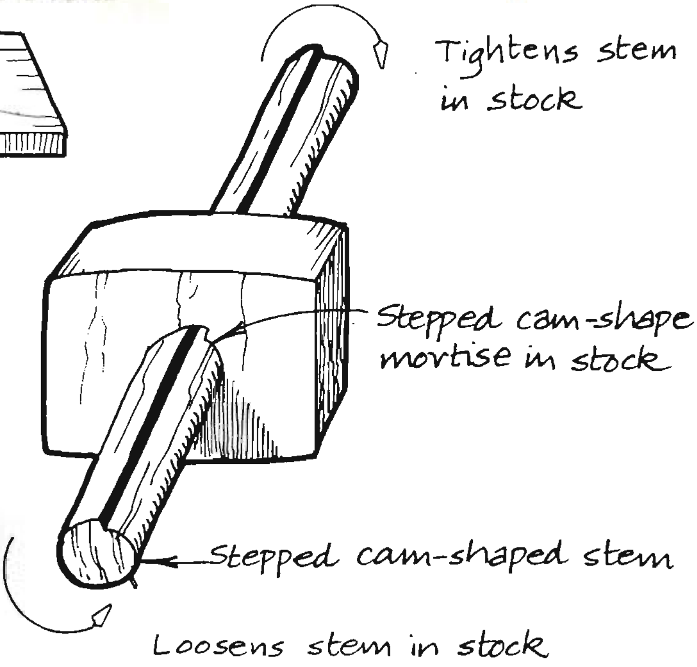
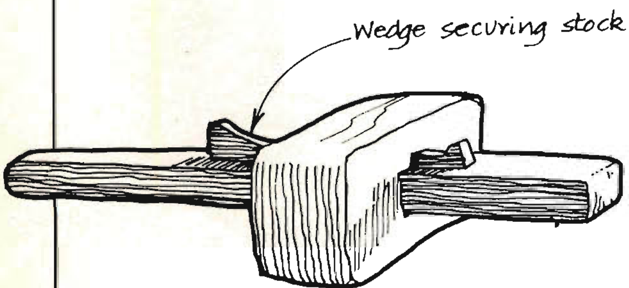
***Graham Blackburn** is a furniture designer/maker in Soquel, California and the author of many books on woodworking and home maintenance, including* Floors, Walls and Ceilings *which is to be published this fall by Consumer's Union.*


Stock held dose to work
Gauge being pushed
Pin tilted to work
Back of stem resting on work

Holding the Marking Gauge

Cam - type Gauge





Usermade Wedged Gauge

stant angle between the gauge and the work. Exactly what this angle is will vary according to whether you are using a marking or cutting gauge, and also according to the material you are working with. Experience will be your guide here, but the degree of success will depend on the level of consistency you are able to maintain.

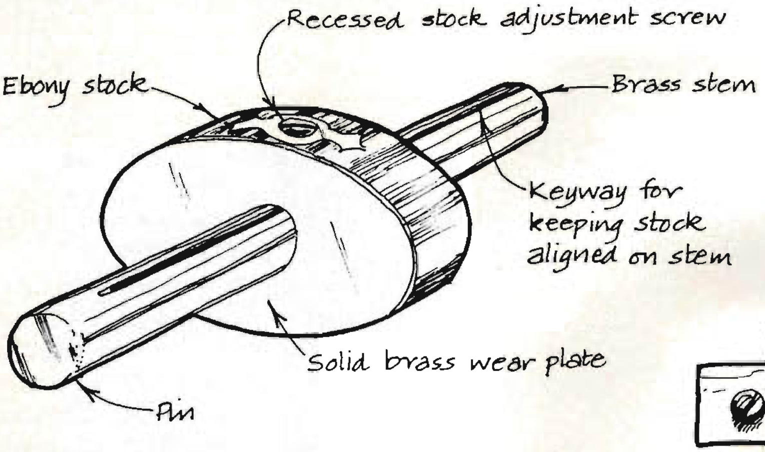
Marking Gauges

There was a time when it was common practice for most woodworkers to make their own gauges. But as a man's business thrived and he began to take pride in his tools beyond what his own toolmaking ability could provide, and as the nineteenth century saw the appearance of specialized toolmakers, more elaborate and sophisticated forms than the simple homemade gauge became common. A few homemade gauges still survive, especially those made for specific purposes in the more specialized woodworking trades such as coopering and wheelwrighting. Apart from the lack of a factory finish, and the frequent use of woods other than beech, these "usermades" are usually characterized by the simple wedge that is used to secure the stock at any desired position on the stem.

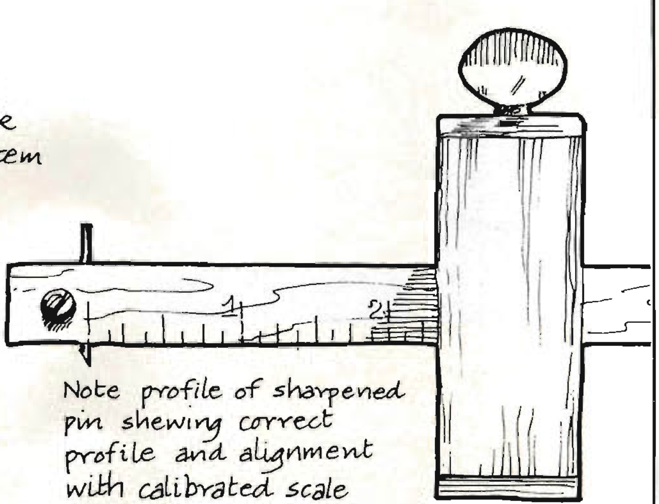
One of the first improvements that factory-made gauges had to offer was in the method of fixing the stock – using a thumbscrew instead of a wedge. You are less likely to move the stock from its desired position when securing it with a thumbscrew than when attempting to fix it with a wedge. There was, however, one interesting form that used neither the wedge nor the screw, and that was the type made with a stem cut in the shape of an interrupted cam. A matching mortise appears in the stock which may be loosened and tightened as desired by simply twisting the stock around the stem.

A superior method of securing the stock, surpassing both thumbscrew and cam method, was achieved with the development of gauges that featured a screw sunk into the stock so that its head was flush. The chief advantage of this method is that it is impossible to alter the setting inadvertently, and furthermore presents less obstruction when you need to turn the gauge in your hand during use.

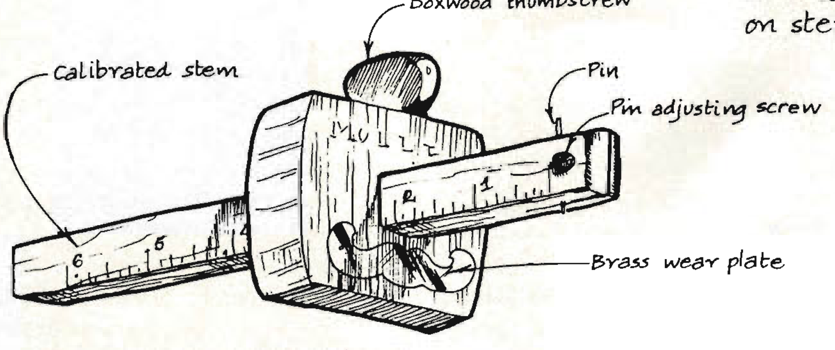
Another factory–made improvement was the inclusion of a wear plate in that part of the stock which bears against the work. Often taking the form of a simple inlaid brass strip, this piece was sometimes very elegantly shaped, and indeed, sometimes covered the whole face of the stock. The value of providing a more durable face to the stock becomes apparent when another improvement that gradually became popular is taken into account. This is the practice of marking the stem in inches and fractions of an inch, starting at the point of the actual marking


Recessed stock adjustment screw
Ebony stock
Brass stem
Keyway for keeping stock aligned on stem
Solid brass wear plate
Pin

Superior Marking Gauge



Note profile of sharpened pin shewing correct profile and alignment with calibrated scale on stem.



Improved Marking Gauge

pin. With the addition of stem calibration, the gauge can be set to any desired measurement without having to juggle a rule, the stem, and the stock in two hands while trying at the same time to secure the locking screw or wedge. Having a wear plate on the stock will keep it accurate when you want to align it with the calibrations on the stem.

Hand–in–hand with calibrated stems goes the need to keep the marking pin precisely located. These pins wear down eventually and become otherwise blunt and need to be resharpened or replaced. Better–quality gauges make provision for this by having the pin secured with its own screw that can be loosened for easy removal of the pin and precise alignment.

Fine Tuning

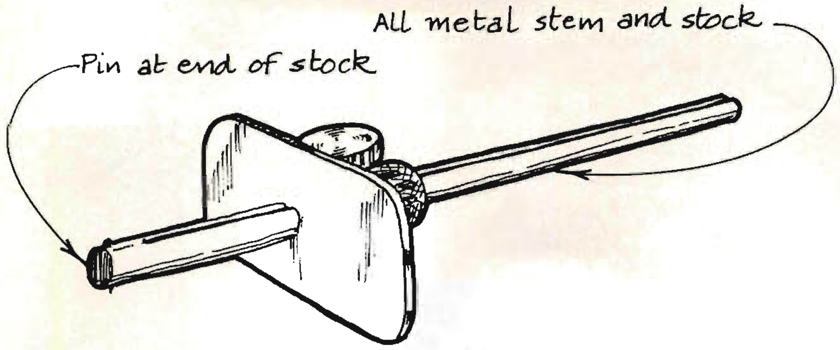
Although the marking gauge appears to be a relatively simple instrument, there are one or two things that can be done to ensure its efficiency and accuracy. The first concerns the actual marking point.

Contemporary gauges are invariably supplied with pins that are far too long, or protrude too much from the stem. The idea is not to inscribe a line in the work that is 1/4" deep, but merely a surface scratch; consequently, the pin does not need to protrude more than 1/8". If you use a gauge with a pin that sticks out much farther than this, you run the risk of having the gauge tilt while in use and losing the parallelism that is the gauge's whole purpose. Reduce the amount of point protrusion by repositioning the pin or filing it if it cannot be repositioned easily. Of course, cheaper gauges that have square stems require their pins to protrude a little more than gauges with round or oval stems to allow the stem to be rotated slightly when being pushed or pulled along the work. (If you attempt to use the gauge with the pin perpendicular to the work, there is a danger that the gauge will stick – and then jump free. The gauge must be tilted a little so that the pin is *not* perpendicular.)

Why a gauge with a square stem should be cheaper might not be immediately apparent. The reason is not that it is easier to make a square mortise in the stock – it is not! – but that a round stem requires some form of keying to keep it aligned within its stock. Should the stock be free to revolve around the stem, it would be impossible to provide wear-bearing and calibration always in the same relation to the stock.

To ensure absolute accuracy when using a gauge with a calibrated stem, file or sharpen the point so that not only is the tip exactly at "ground zero," but so that the inside edge of the pin is flat and any beveling is on the outside of the pin – the side farthest from the stock.

That the stock should not rock on the stem is also important; mere torquing


All metal stem and stock
Pin at end of stock

Machinist's type Gauge

down on the retaining screw will not necessarily ensure this. Better–quality gauges should have a tiny pad inside the stocks to prevent the screw from eating into the stem. If it's missing, you can make a new one from a piece of scrap brass, a blind washer, or even a small coin. If the mortise in the stock is too worn, the gauge may have to be discarded in favor of a tighter–fitting unit.

Varieties and Adaptations

Even the humblest beechwood gauge, devoid of wear plate and adjustable pin, will provide accurate service, but keep an eye open for the aristocrats: ebony masterpieces with stocks faced entirely with brass; gauges with flush mounted stock-securing screws; oval–stocked models and models with solid brass stocks; and gauges made entirely of metal. These last examples – often intended as machinists' metalworking gauges – are extremely useful since the pin is often placed much nearer the end of the stem than it is in wooden models, thereby enabling the gauge to be used close up in a rabbet or corner.

An especially useful find is a marking gauge that has a head designed to be reversible – one side is flat (for regular straight work) and the other face is fitted with a double–nubbed brass plate which enables the gauge to be drawn along curved work.

The Mortise Marking Gauge

By far the commonest specialty marking gauge is that designed to mark double lines – such as when laying out mortise and tenon joints. Simply because this gauge needs to be provided with two pins instead of one automatically guarantees it as being a more sophisticated tool – more liable to having been made with greater attention to detail. But there *are* mortise gauges devoid of brass and screws. Mortise gauges made with one fixed setting have their place. If you commonly lay out one particular size of mortise and tenon in consistent stock, there is a virtue in having a fixed gauge: it can never lose its setting.

The commonest form of mortise gauge is that where the inner pin's adjustment mechanism is operated by a thumbscrew located at the end of the stem. Unless this adjustment is kept scrupulously in order, this type of gauge can be prone to sudden and unaccountable inaccuracies. By far the best kind is that where the inner pin is adjusted by means of a screw *inset* in the end of the stem. Not only does this arrangement prevent inadvertent readjustment, it provides for a much tighter and more secure movement of the pin.

An equally secure adjustment is also possible with another type of mortise gauge – but at the price of a certain cumbersomeness and an extra motion. This is the two–bar mortise gauge wherein each pin is set in its own bar, both bars being contained within the same stock. It is cumbersome to use since only one line at a time can be scribed and the gauge must be turned over and used a second time in order to achieve the marking of two lines. There is also the commensurate difficulty of having two stems to adjust and secure instead of just one. However, very handsome models of this type were occasionally made in ebony and brass, and perhaps the pleasure in handling such an attractive tool offsets any inconvenience in using it.

Cutting Gauges

The second main group of gauges is comprised of those gauges which use a small knife instead of a pin, and which cut rather than score a line. As they get larger, these gauges merge into the slitting sort; but at the smaller size, they are frequently preferred substitutes for the regular marking gauge.

Be the point of a marking gauge ever so sharp, it will still *tear* the fibres of the work it is marking. The knife edge of a cutting gauge will *sever* the fibres and leave a much sharper and clearly formed line. When laying out a line that must be pared to with a chisel, I find a cutting gauge infinitely better to use since the edge of the chisel sits much more precisely in the line cut by the cutting gauge, leaving a sharp and clean cut.

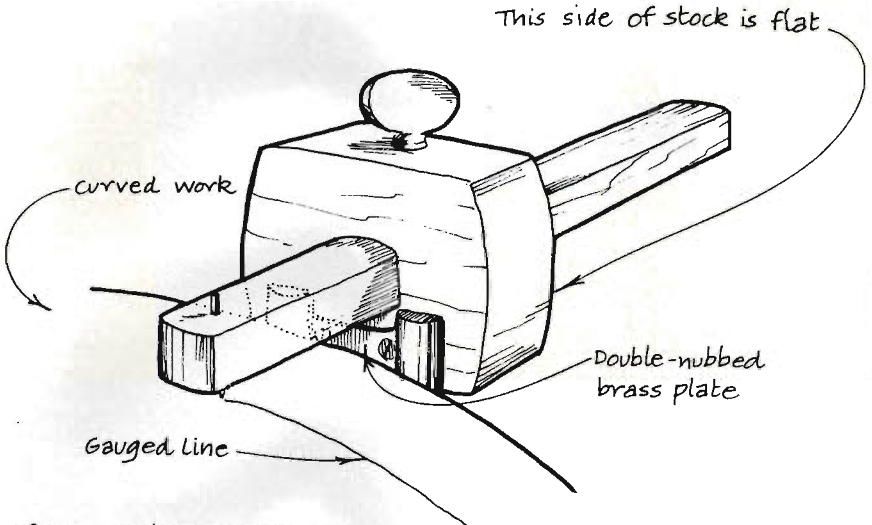
Whatever the size of the cutting gauge (and they come in a broad range of sizes), the most important point to bear in mind is the shape of the cutting edge itself. Whether it is formed so as to be used in both directions or only in one direction, the inside face of the blade (nearest the stock) must be perfectly flat, and all beveling and sharpening be effected on the outside face. Should the bevel be formed on the inside of the blade, the cutting edge will tend to wander away from the line. By having the inside of the blade flat, the bevelled edge tends to force the knife–like edge towards the face of the stock, and a parallel line is cut with no effort.

However, in common with the marking gauge, care must be taken to see that not too much of the blade is exposed or accuracy will be compromised – and you will have to work harder to cut your line.

Just as with other classes of gauges, cutting gauges exist in a wide variety of qualities, but all share the ability of having the blade easily removed (for sharpening) and adjusted.

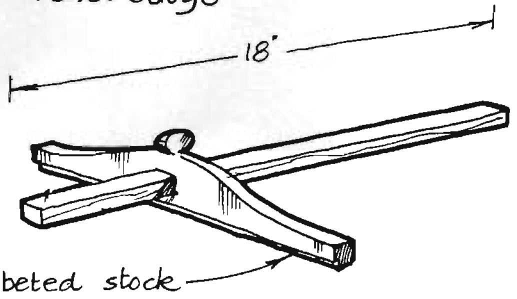
A cutting gauge is not a common tool

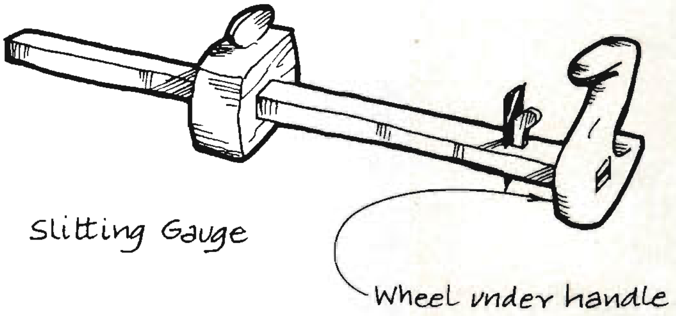
in many workshops, yet I would be seriously disadvantaged without one in mine. Apart from marking dovetails (so as to be able to chisel a sharp edge – on those parts that will not be seen), the cutting gauge is invaluable when forming any kind of groove, dado, or rabbet that is to be cut with a plane rather than a router; severing the fibers ensures that the plane (even those equipped with spurs) will cut a clean edge. This is especially useful when planing raised panels – having first marked the central field with a cutting gauge guarantees crisp shoulders.



Gauge with Stock fitted for curved Work

Panel Gauge





Slitting Gauge

Panel and Slitting Gauges

The last group under discussion is defined mainly by the larger size of its members. These tools tend to be around 18" in length, although longer examples are not rare. Panel gauges typically have flattened and lengthened stocks, usually with the bottom inside edge formed into a small rabbet so that the stock may ride more securely against the work. This is useful and indeed even necessary since the work is commonly a thin panel which may be wavy and present an edge that would be difficult to hold a regularly shaped stock against.

In the contemporary workshop the panel gauge functions as an extra large marking gauge, for there are frequently occasions when one needs to mark a line farther from the edge than the common marking gauge can accommodate.

Slitting gauges, on the other hand, while just as long as panel gauges, do not have such elongated stocks since their operation is different. Their primary use is for slitting thin panels; consequently, a fair amount of pressure is required not so much to keep the stock up against the work as to force the cutting edge into and through the material being worked. To this end they are furnished with handles at the outboard end, past the blade.

Better models are fitted with rollers or little wheels under these handles so that the tool will pass more easily over the work, despite the fact that its blade is *in* the work. With a tool such as this it becomes of paramount importance to see that the blade is adjusted precisely. Too deep and you will bog down, all progress being halted or rendered totally inaccurate; too shallow and the pressure necessary to bring the blade into contact with the work will end up gouging the wheel into the work.

As a matter of incidental interest it should be noted that many "universal" or "combination" planes are provided with the means for being used as slitting tools; yet being so much heavier they are less wieldy, and it is easier to hurt yourself with the pointed blade.

Aside from slitting thin panels accurately, the slitting gauge is a handy tool for cutting veneer, slicing off battens or lathing strips, and separating beading when it is being made into doweling. As with many other tools, it is not until they are incorporated into one's arsenal that it is realized how indispensable they are. So keep an eye out for unusual gauges – they are not always what they may appear at first glance. **PW**

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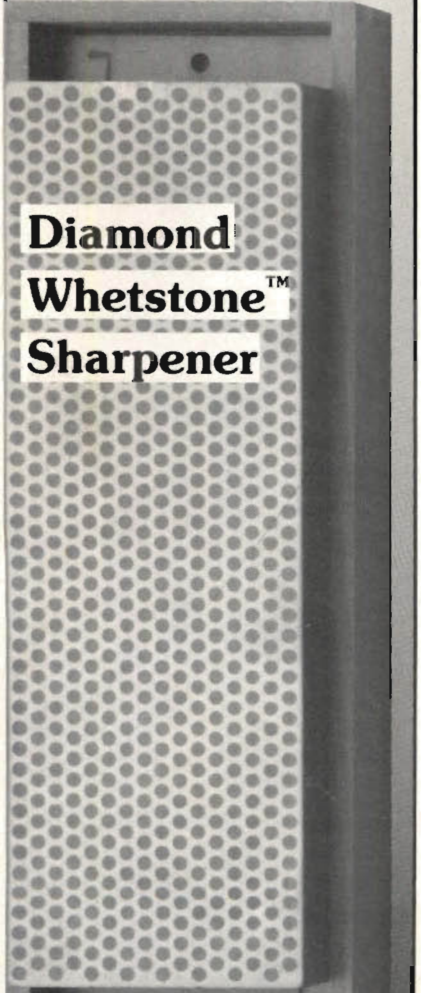

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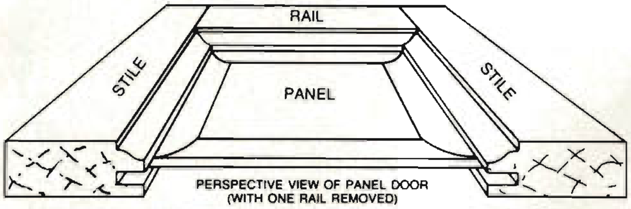

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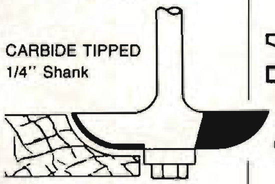

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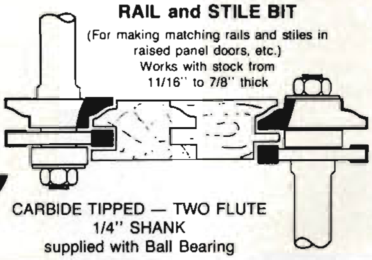

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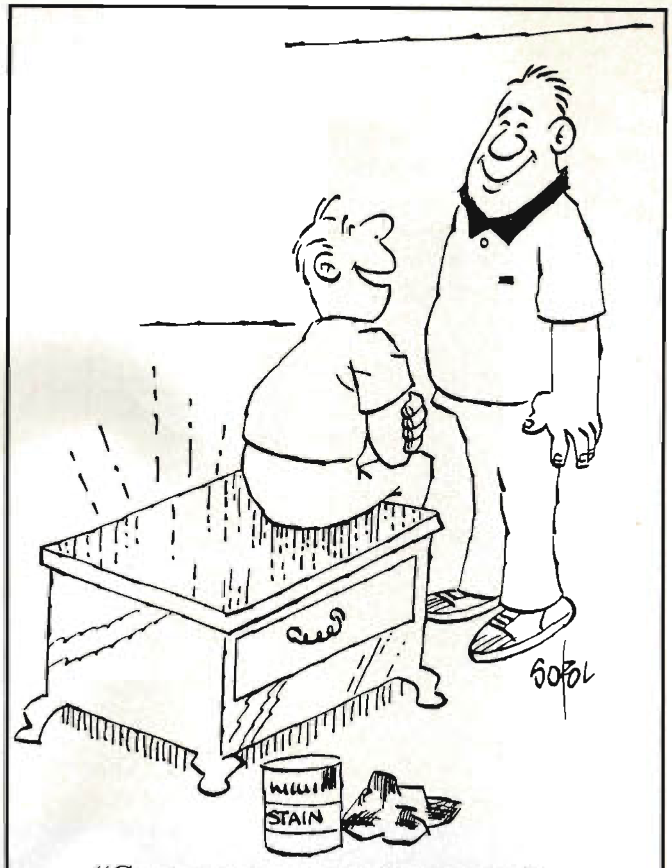

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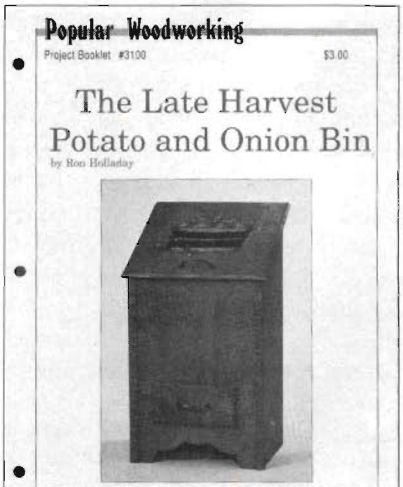

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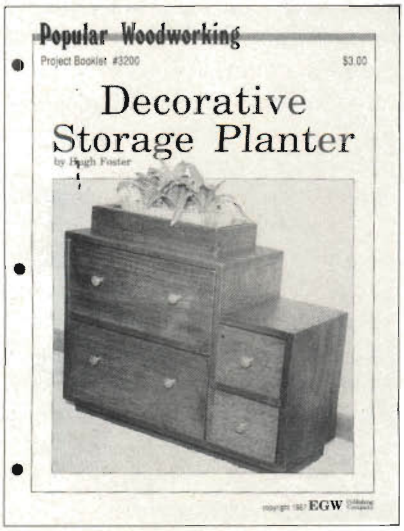

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Designing for Dimensional Change

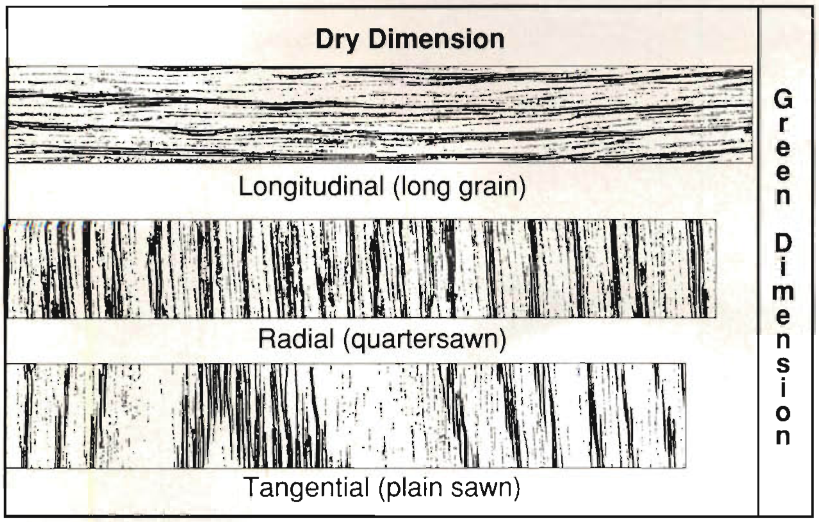

Figure 1. This chart illustrates the amount of shrinkage that can occur in wood, from its freshly cut green state to its dry dimension. Notice that the longitudinal grain which represents the length of a board varies only slightly.

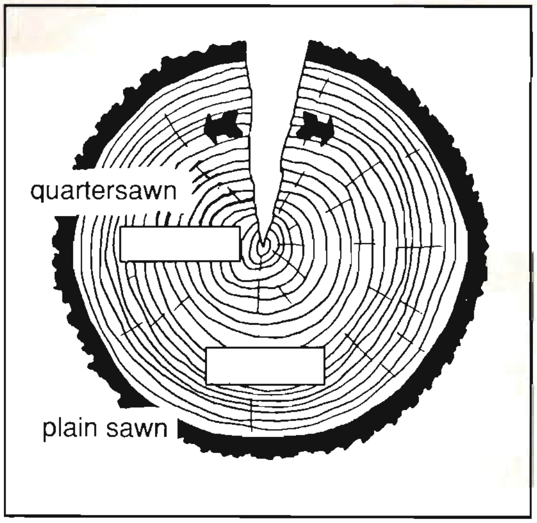

Figure 2. Tangential shrinkage can exert enough force to split a log as it dries. When lumber is quartersawn, it shows less dimensional change across the width than wood that is plain sawn.

by Sam Allen

The living quality of wood that makes it such a beautiful material to look at and work with can also create problems if it is not properly dealt with in the design of a piece. Variations in humidity will cause the wood to shrink or swell no matter how thoroughly dried. This is a fact that every woodworker using solid lumber must design for. If dimensional change is not taken into account, cracks, loose joints, and ill–fitting doors and drawers will result.

Hundreds of years of trial and error have produced many time–tested techniques for accommodating wood movement. As modern woodworkers get used to dimensionally stable materials like plywood and particle board, we may forget to use these techniques. If we do, the results can be disastrous.

While a tree is alive, the cell walls of the wood are saturated with fluid. The fluid level stays fairly constant and the cells remain dimensionally stable. Once a tree is cut, the cells begin to dry and shrink. From this point on, wood is dimensionally unstable.

As long as the humidity is constant, the wood will be dimensionally stable. If a piece of furniture is built in a climate that has a relatively constant humidity, design faults may not show up until the piece is moved to a different environment. A modern home with central heat and air–conditioning can prove to be a more hostile environment for furniture than a drafty old cabin ever was. So even if you are making a direct copy of an old piece of furniture, you may need to pay more attention to dimensional change than the original builder did.

Dimensional change begins at the cellular level. The longitudinal grain is the most stable dimension of a board; the cells stay almost constant in length, varying less than 0.3% no matter what the moisture content. Notice in Figure 1 that the total shrinkage from green to dry is almost imperceptible in the longitudinal grain section. It's the diameter of the cells that increase or decrease with fluctuating moisture. The actual change in size of each cell is minute, but the cumulative effect of thousands of cells adds up to a substantial change in dimension. The more cells that are involved, the greater the change. This means that the wider a board is, the larger the possible amount of change can be. For example, a 6" wide board may be stable to plus or minus 1/16" while a similar board that is 12" wide will only be stable to plus or minus 1/8". In other words, the actual size of the 12" board may vary by as much as 1/4" when the humidity changes from one extreme to another.

The thickness of a board also changes, but since most boards are 1" or less in thickness, the effect is usually negligible. Thicker boards and boards that were not dry when used can shrink enough in thickness to create a problem.

Because of the structure of the cells, more shrinkage occurs in the direction **tangent** to the rings than in the **radial** direction. Notice in Figure 1 that the total shrinkage from green to dry for the tangential section is nearly twice that of the radial section. Tangential shrinkage is the force that causes checks and cracks in logs as they dry. In plain sawn lumber the width of the board is tangent to the rings, while in quartersawn lumber the thickness is tangent to the rings (see Figure 2). This means that quartersawn lumber is more dimensionally stable in width than plain sawn lumber, but plain sawn lumber is more stable in thickness. Since thickness is less critical than width, quartersawn lumber is considered to be more dimensionally stable. Still it will shrink and swell, so even when using quarter sawn lumber, special design considerations must be taken to accommodate the movement.

Many conventional woodworking techniques are based on principles of dimensional change. Even though these concepts are second nature, it's good to analyze them so when an unusual situation arises, you can put the concepts to use correctly. The first of these conventions is to decide which dimensions are the most critical in a finished piece, and align the grain so that these dimensions will be the least affected by wood movement. For example, the opening around a door or drawer is a

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***Sam Allen** is the author of the book* Making Cabinets & Built–Ins: Techniques and Plans *from Sterling Publishing Co.*

critical dimension. If it changes appreciably, the drawer will stick or large gaps will appear around the drawer. Since the longitudinal grain of a board is the most stable, the boards should be placed so the grain runs around the opening, as shown in Figure 3A. Most of us would naturally align the grain this way simply out of convention and because any other alignment would require a lot more gluing up. But if the nightstand pictured in Figure 3 were about 12" wide, it would be easy to align the grain as shown in Figure 3B, cutting the top, shelf and bottom from 12" wide stock without gluing up to make the width. If the nightstand were built in this manner, the drawer opening could change in width by as much as 1/4" in extreme humidity variations.

We traditionally make stiles and rails 1-1/2" or 2" wide. Older designs sometimes incorporated wider stiles and rails, but craftsmen discovered that the size of the opening could change too much. You can actually use any width up to about 4" and still be safe. In most cases a 4" wide board will be stable to plus or minus 1/32" and a 2" board will be stable to plus or minus 1/64". Change this small can be accounted for in the normal door or drawer clearance.

Doors made of solid lumber require more attention than practically any other design area since they are usually wide and must fit into an opening under all humidity conditions. The best time-proven method for making a stable door is frame and panel construction. The frame is made from narrow boards that won't change appreciably in size (see Figure 4). The panel will vary in size according to humidity; but since it is left loose in the grooves, it won't distort the frame and the overall size of the door will remain the same. When building panel doors, be sure that no glue from the frame joints gets into the panel groove or it may prevent the necessary movement of the panel. Make the grooves deep enough to allow for all of the anticipated movement of the panel. If possible, you should stain the panel before placing it in the frame, so if it shrinks after installation, there won't be an unstained area showing around the edge. A small dab of silicone rubber glue in the center of the end grain ends of the panel may be used to hold the panel in proper alignment.

If two boards are joined with their grain running at a 90° angle to each other, problems will result. This is called cross grain construction. When boards are firmly attached to each other in this manner, movement across the width of one board is constrained by the relatively stable longitudinal grain of the other. The usual result is that the wide board splits as it shrinks.

Drawer guides can often lead to cross grain problems if they are not carefully designed. Figure 5A illustrates a type of drawer runner and dust

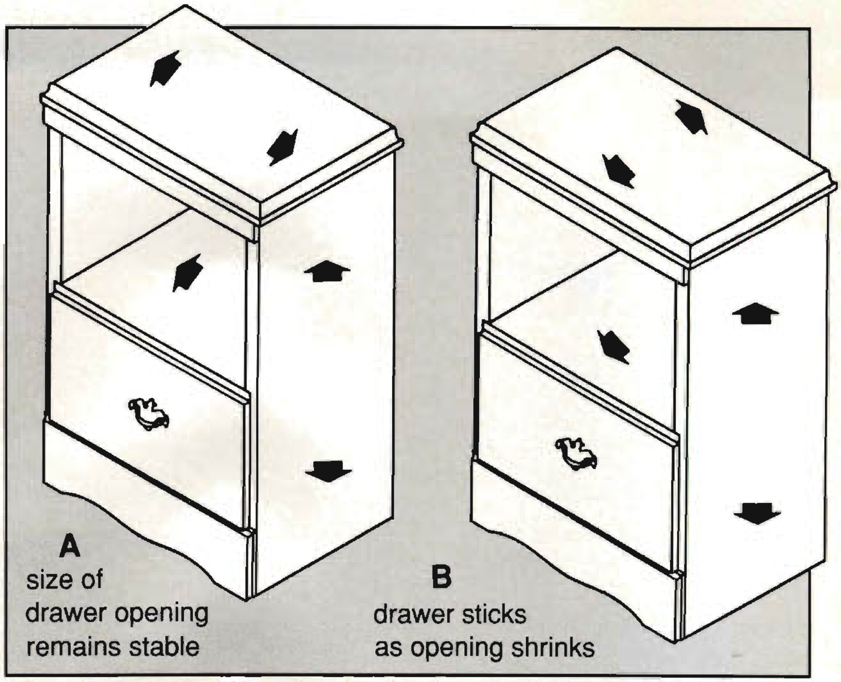
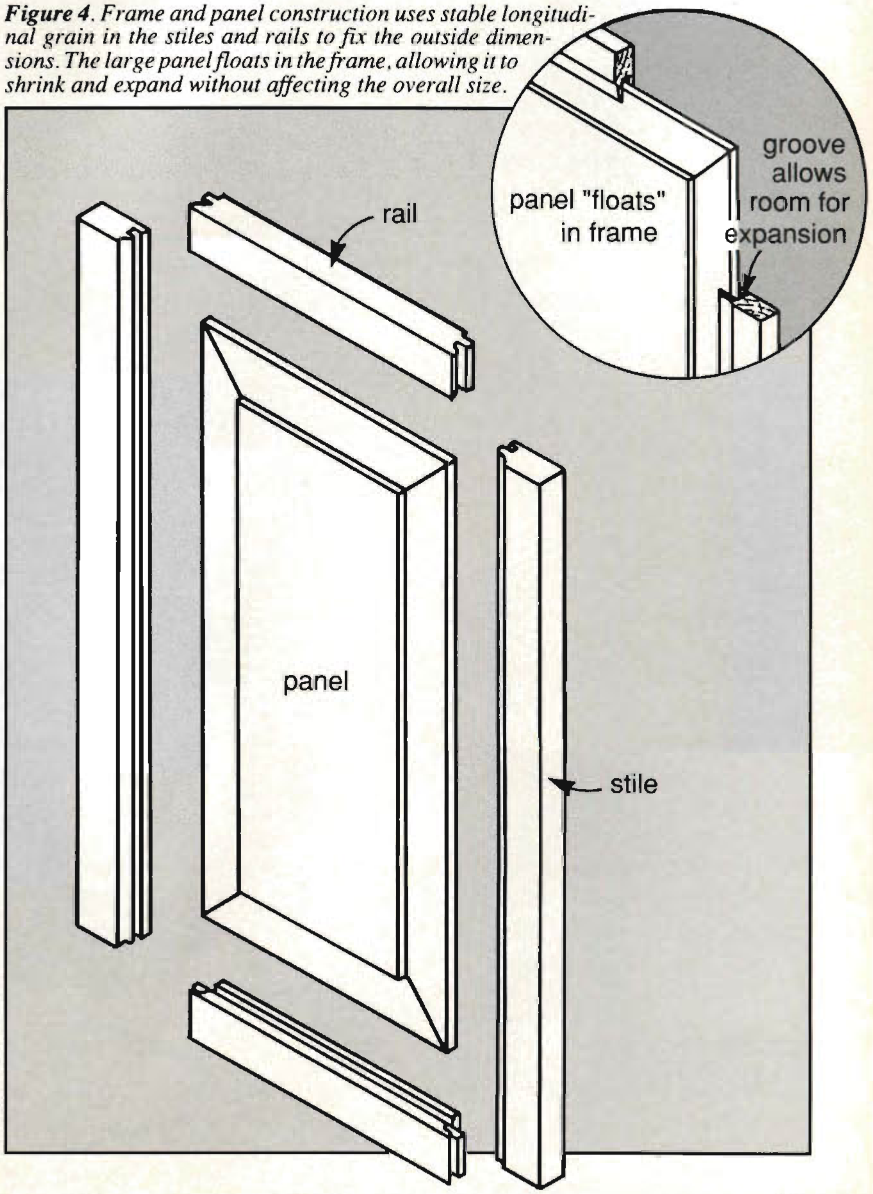


Figure 3. Grain should be oriented so that dimensional change will not affect the size of critical openings.

Figure 4. Frame and panel construction uses stable longitudinal grain in the stiles and rails to fix the outside dimensions. The large panel floats in the frame, allowing it to shrink and expand without affecting the overall size.



illustrations by the author

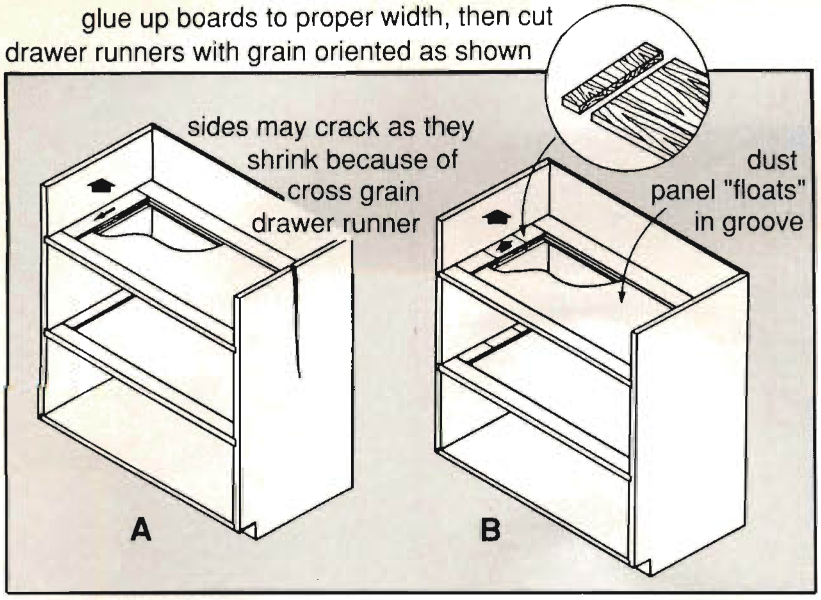

glue up boards to proper width, then cut drawer runners with grain oriented as shown
sides may crack as they shrink because of cross grain drawer runner
dust panel "floats" in groove
A
B

Figure 5. *Cross grain construction can lead to splits as shown in A. The grain orientation in B eliminates these problems.*

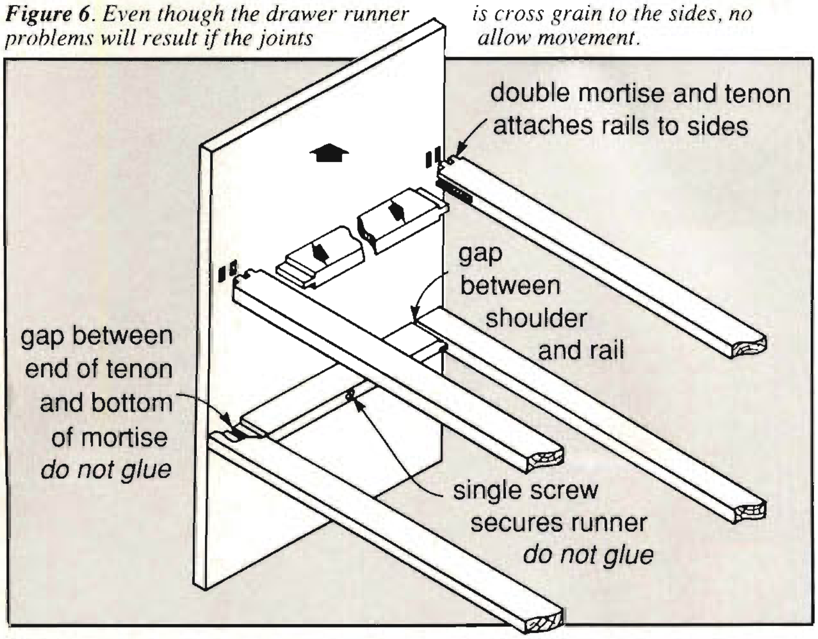

double mortise and tenon attaches rails to sides
gap between shoulder and rail
gap between end of tenon and bottom of mortise
do not glue
single screw secures runner
do not glue

Figure 6. *Even though the drawer runner is cross grain to the sides, no problems will result if the joints allow movement.*

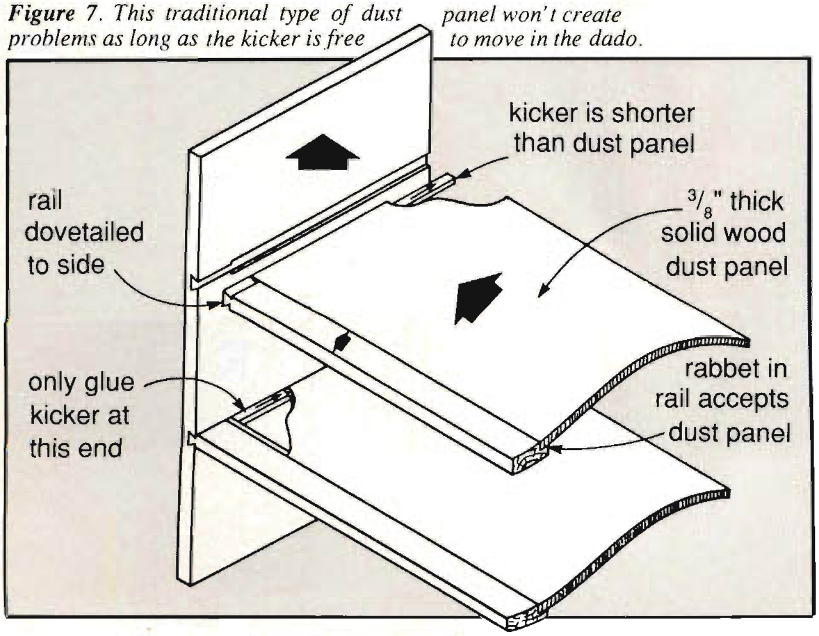

kicker is shorter than dust panel
rail dovetailed to side
3/8" thick solid wood dust panel
only glue kicker at this end
rabbet in rail accepts dust panel

Figure 7. *This traditional type of dust panel won't create problems as long as the kicker is free to move in the dado.*

illustrations by the author

panel construction that is commonly used in plywood carcases. If this type of frame is rigidly attached to a solid wood side, the result may be a cracked side. To use this type of dust panel construction and still align the grain properly, the drawer runners must be cut from boards that have been glued up to width with the grain running as shown in Figure 5B. If you use this technique, substitute dowels for mortise and tenon joints on the frame because a tenon that has the grain in this orientation is not very strong. You can keep the longitudinal grain alignment of the drawer runners and still accommodate the dimensional changes of the sides by using the design shown in Figure 6. The rails are firmly attached to the sides with double mortise and tenon joints.

The runners are attached to the rails with mortise and tenon joints, but the joints are not glued; a single screw in the center of the runner attaches it to the side. The runner is shorter than the distance between the rails, leaving a gap for movement in the joints. The size of the gap depends on the width of the side. For sides up to 12", a gap of 1/16" will usually be sufficient; sides that are 24" wide need a 1/8" gap in the joint, and wider sides a proportionally wider gap. This assumes that the side is at about the midpoint of its possible shrinkage and expansion. If you know that the humidity has been especially low or high, adjust the size of the gap accordingly. When solid wood is used for the dust panel, the design shown in Figure 7 can be used. The front rail is dovetailed into the side to tie the carcase together. The dust panel is thinner than the rail, and it rests in a rabbet in the front rail and a dado in the sides. Align the grain of the dust panel with the sides. A strip of wood (a kicker) fills in the space between the bottom of the dust panel and the bottom of the dado. The kicker keeps the drawer below from tipping as it's pulled out. With this type of construction, you must take care to avoid cross grain problems caused by the kicker. Leave a 3/8" gap between the end of the kicker and the back of the carcase. If the kicker is butted against the back, it may push the back out of its joint as the sides shrink. The kicker must also be left free to move in the dado for most of its length. Attach it firmly only at the front end.

Problems caused by movement of the sides can be totally eliminated by using framed panels for the sides. Figure 8 illustrates a type of construction called post and panel. Posts at each corner form the legs and side rails. The panel fits into a groove in the post. Drawer guides are attached to the posts with mortise and tenon joints, but they are not attached to the panels in any way, so the panels are free to float in the frame. The front drawer rails are joined with double mortise and tenon joints to the posts. The drawer runners are attached to the rails with mortise and tenon joints and screwed to the drawer guides. This arrangement makes the overall dimensions of the carcase stable; all of the dimensional change is accommodated for in the floating panels.

In some cases, cross grain construction cannot be avoided. You must allow for movement between the parts and *never* glue them securely together. Solid tops are a particular problem because they are usually wide and the frame they attach to is made dimensionally stable by the longitudinal grain of the rails. Figure 9 shows two methods that can be used to allow top movement. These techniques can be used separately or in combination as shown here. To keep the front of the top in proper alignment with the front of the chest, it is screwed securely along the front. All of the expansion or shrinkage needs to be accommodated for at the rear with slotted screw holes. This can be done by drilling two holes side by side and cutting out the wood between them, or by making a plunge cut with a router. Use round head screws with washers so the screw head doesn't jam in the slot. Place the screw in the center of the slot so that the top can move in either direction. Another method is used to attach the top to the sides. Here metal clips are screwed to the top. The clips fit into a groove in the side rail.

Since plywood and particle board are dimensionally stable, care must be exercised when mixing these materials and solid lumber in the same project. When the plywood or particle board is attached to longitudinal grain on solid lumber, there will be no problem. The back of a carcase usually attaches to longitudinal grain on all four sides, so it is safe to use plywood for the back of a project that is otherwise made of solid lumber. When the plywood is attached to the end grain of the solid lumber, a cross grain condition exists. For example, if you use solid lumber for the sides and plywood for the top or bottom, the sides may split. If a plywood top is attached to solid wood sides, use the techniques shown in Figure 9. Since panel construction is as stable as plywood, you can use plywood for the bottom, or a plywood top can be attached directly to panel sides, eliminating the need for slotted screw holes or clips.

If you consider how wood moves as you design your projects you can avoid problems later. You will soon be able to adapt these techniques to special situations and come up with your own solutions to unique problems. PW

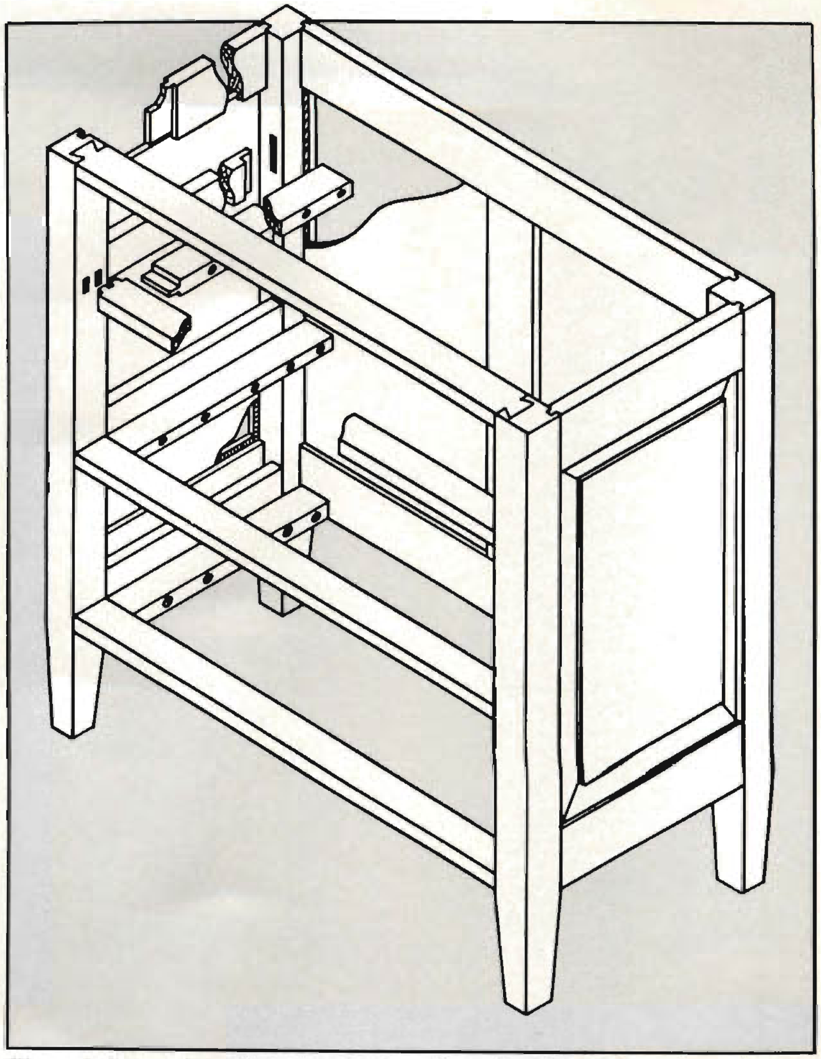
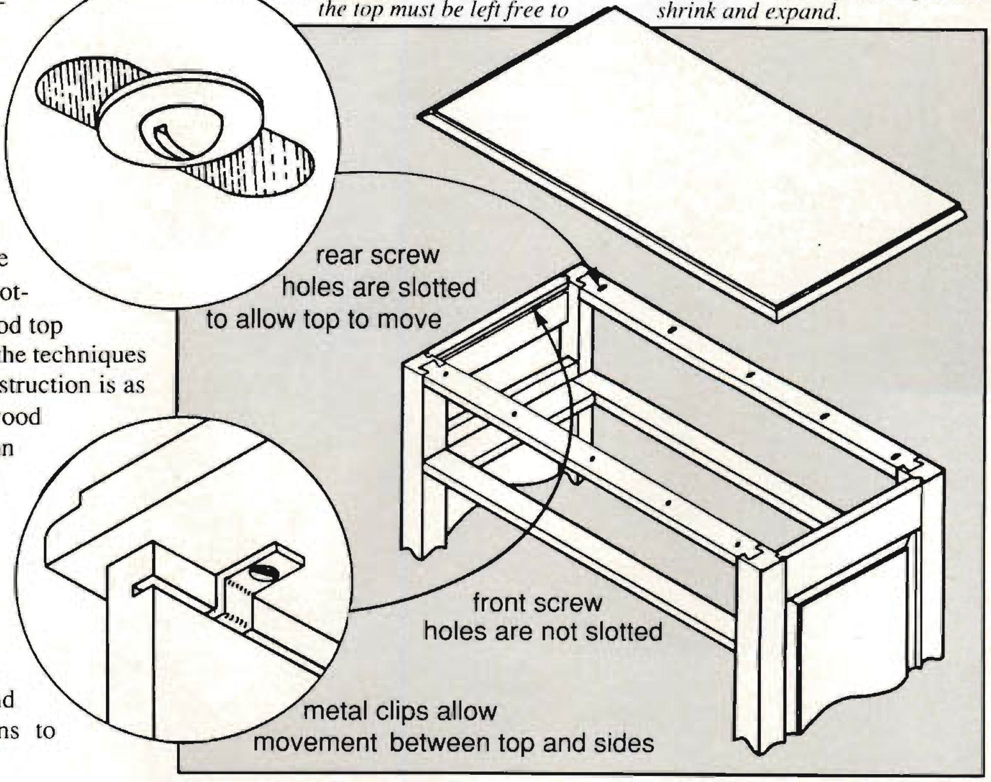
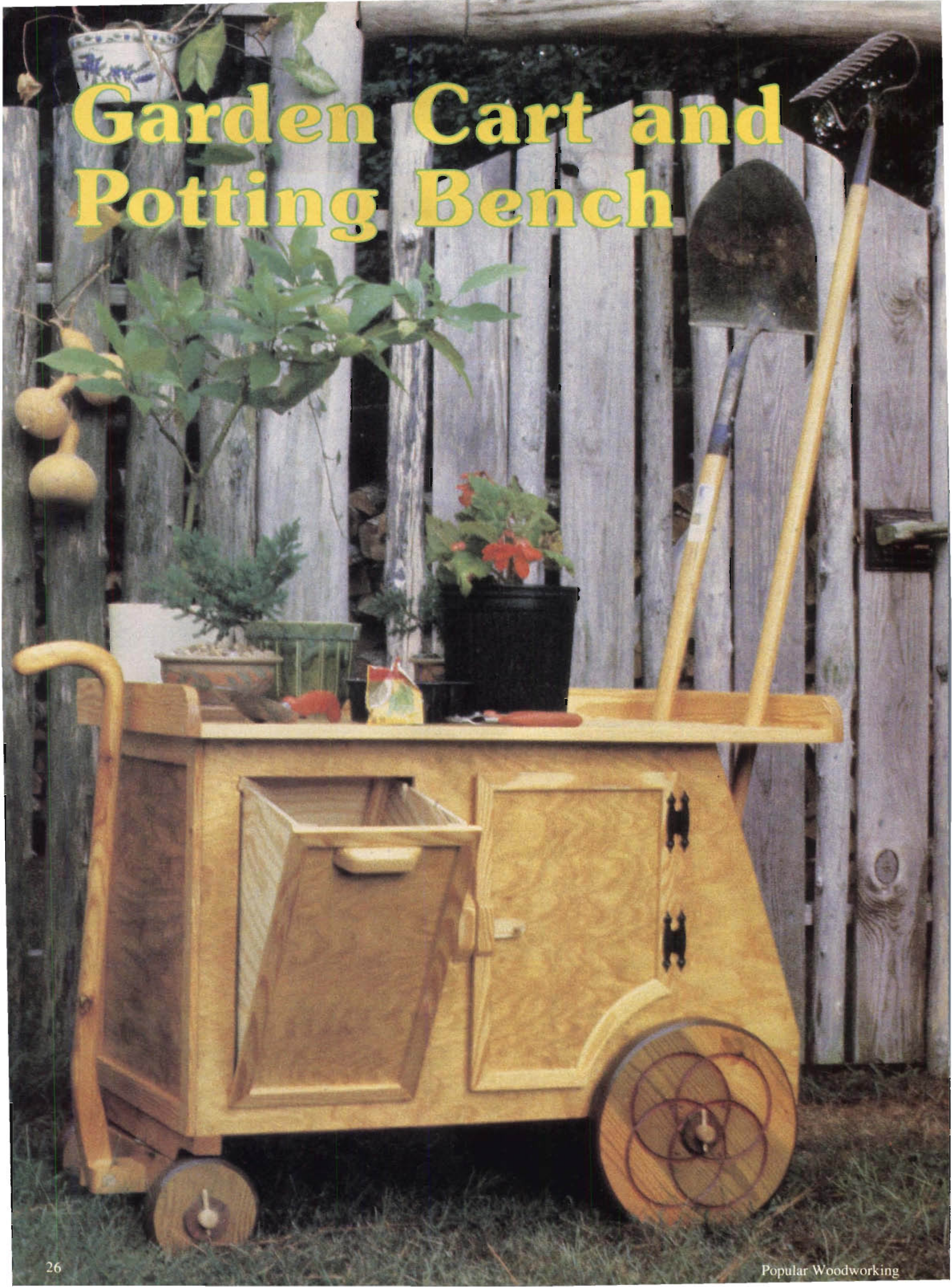


Figure 8*. Post and panel construction is as dimensionally stable as plywood.*

Figure 9*. When a solid top is installed on a dimensionally stable frame, the top must be left free to shrink and expand.*



Garden Cart and Potting Bench



A Popular Woodworking Project

by Tom Crabb

The idea behind this garden cart is to transport gardening tools and supplies all at once to the spot where they are needed. As it turns out, it is also a perfect place to set a drink, the cordless phone and the portable radio for listening to the ball game while you work in the garden.

Garden Cart Chassis					
Cutting List					
		Finished Size			
Qty	Part	T	W	L	Piece
2	A	1½"	2"	20"	frame pieces
1	B	1½"	2"	30"	center beam
1	C	1½"	3½"	17"	axletree
1	D	1½"	3½"	4½"	handle hasp
1	E	1½"	3½"	38"	handle*
1	F	¾" dowel		4"	axletree pivot
4	G	1" dowel		4"	axles
2	H	1½"	13" diameter		rear wheels
2	I	1½"	6¼"diameter		front wheels
4	J	½"	2½"diameter		washers
4	K	¼" dowel		2⅜"	linchpins
1	L	¾" dowel		3½"	handle pivot

* dimensions indicate rough stock needed

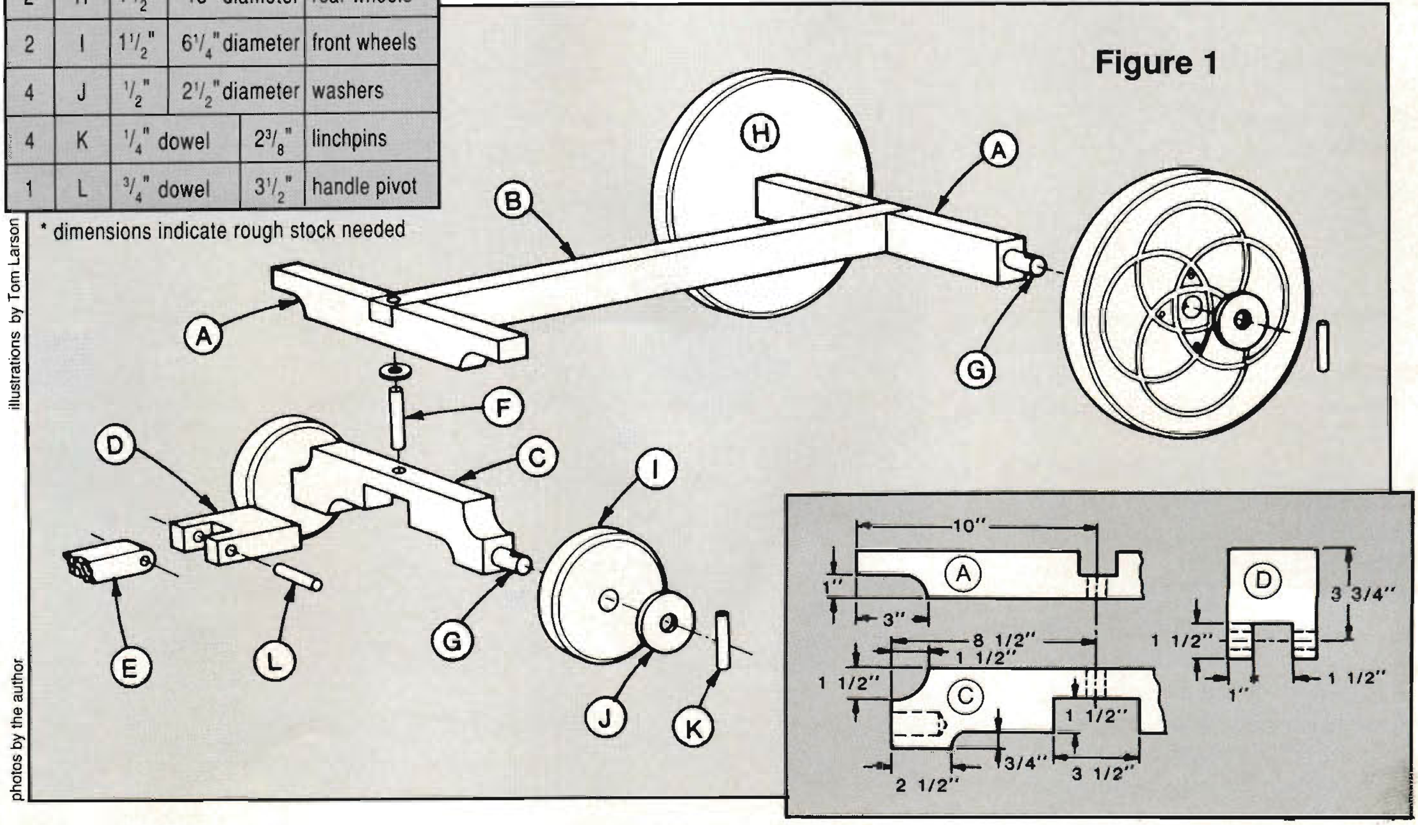
The potting soil bin will hold about 20 pounds of soil and the cabinet area holds spare pots, fertilizers, small hand tools and work gloves. The three holes at the end of the bench top hold the shovel, rake, and hoe keeping them safely out of the way but handy.

The Chassis

The "I" chassis consists of three parts: the front and back frame pieces (A) and the center beam (B) made from yellow pine 2 X 4's ripped to 1-1/2 " X 2". Cut a 3" long, rounded notch in the ends of the front frame piece (see Figure 1) to allow clearance for the front wheels. Assemble the three members with glued half-lapped joints.

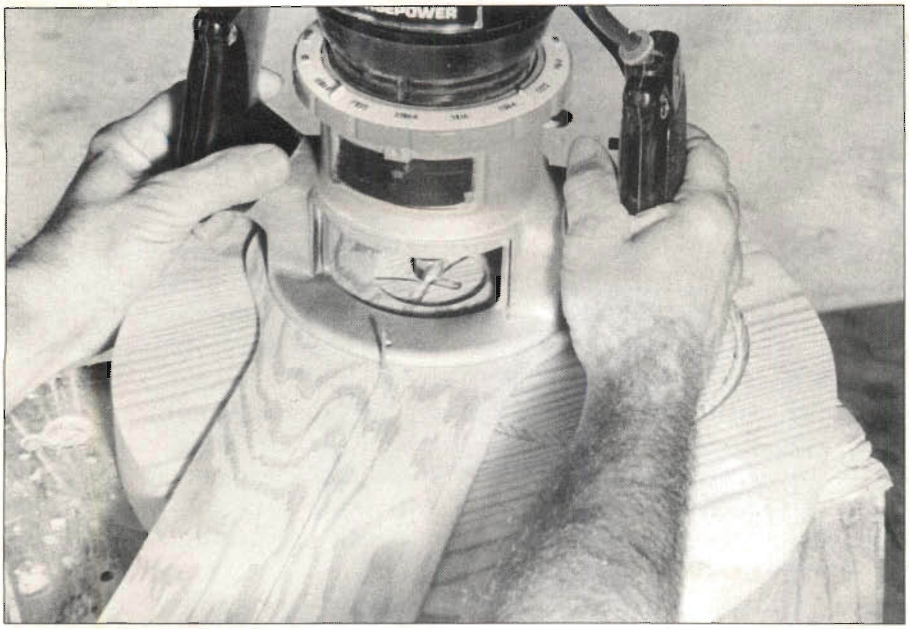
Make the axletree (C) from 2 X 4 stock as well, and shape it for ground and wheel clearance (see Figure 1). Cut a 2 X 4-sized notch in the underside of the axletree to accept the handle hasp (D). The hasp will need a 1-1/2" X 1-1/2" notch for the handle (E). Drill a 3/4" hole centered in the top of the axletree and a matching one in the underside of the front frame piece to accept the axletree pivot (F) and glue the pivot into just the axletree. Drill 1" diameter holes 2" deep into the ends of the axletree and the back frame piece (A) to accept the axles (G) which are glued in place.

All four wheels are made from treated 2 X 6 pine. Three 14" lengths are edge–joined to make the rear wheels (H) and two 7" lengths are edge–joined for the front wheels (I). (Remember to wear a dust mask when sawing or sanding treated lumber.) Cut the wheels to round, but rout the decoration on the back wheels before drilling the axle holes. I used a trammel jig mounted to my router base to rout four 6" diameter circles with their centers set 2" from the center of the wheel. Cut a 1/4" chamfer around both edges of each wheel by setting up a fence on a tilted band saw table. After final sanding, I stained the



illustrations by Tom Larson
photos by the author

***Tom Crabb** learned woodworking as a boatbuilder. He is the author of* Making Wood boxes with a Band Saw, *and his new book,* Band Saw Projects *is due out this spring from Sterling Publishing Co.*



Make a plywood trammel jig to rout the circle detail in the wheels.

wheels and painted the outside edges and chamfers with two coats of brown enamel, and the routed pattern with two coats of red. The wheels were then given two coats of exterior varnish. The final touch on the wheels is to rub the axle hole with petroleum jelly to help seal it from moisture and to ease the friction.

Slip the wheels onto the axles. I made the washers (J) out of walnut, but any durable hardwood will do; fit one between each wheel and its linchpin (K). The linchpins are 1/4" dowels that are tapered slightly to fit snugly into 3/16" holes.

The handle (E) is made of 2 × 4 stock that has a main length of 32" with a 6" length half–lapped at an angle of about 105° (see Figure 2). The angle is not critical; as long as it's over 90°, it will allow a wide comfortable curve for the hand. Saw out the profile on the bandsaw cutting a small amount of taper from the base to the curve. The rest of the shaping is done on the nose of a belt sander and final sanding by hand.

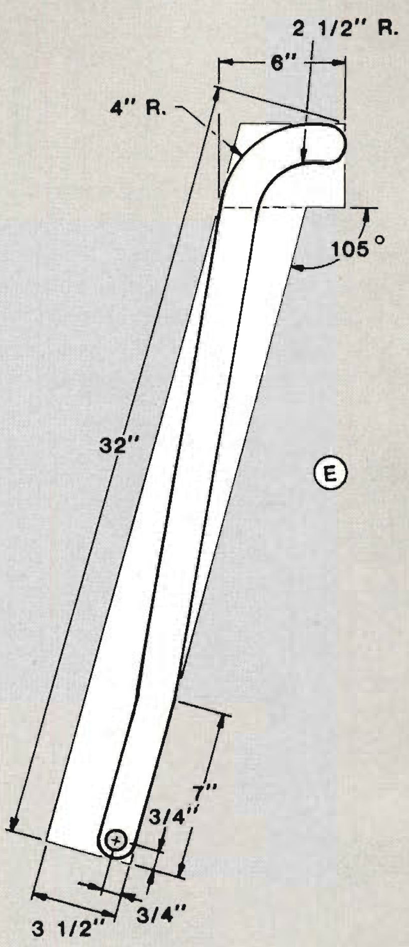
Drill through the handle and its hasp simultaneously with a 3/4" bit, and install the handle pivot, (L) gluing just the ends that contact the hasp.

The Body

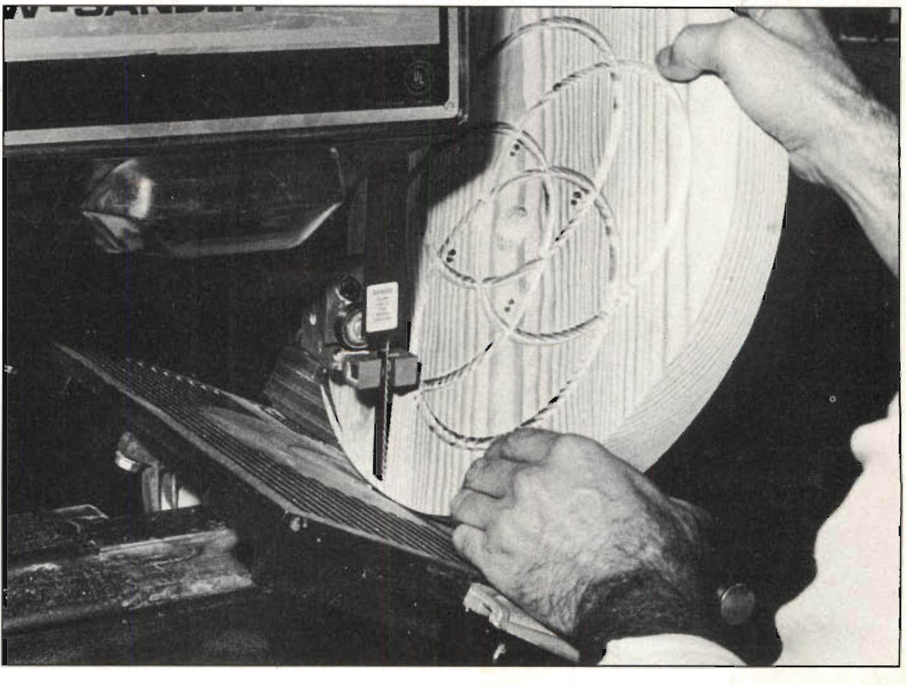
The next step is to build the bed onto the chassis. Position the five bed boards *(M) flush with* the front frame piece (A) and spaced 5/16" apart. This leaves room for the 1/2" plywood sides to land on the chassis with a spare 1/8" for wheel clearance. Nail the bed to the chassis and then position the bottom cleats (N) and screw them in place (see Figure 3).

Cut the ends (O and P) and sides (Q) to size according to the cutting list. Lay out and cut the slope at the rear end of the sides (see Figure 4) and choose one in which to cut the doors. Cut out the doors using a portable circular saw set just deep enough to cut through the 1/2" plywood. With the power off, tip the saw up onto the front of its base, line the blade up with the layout line, then turn on the saw and

Figure 2



Chamfer the edges of the wheels using a fence and a tilted table on the band saw.



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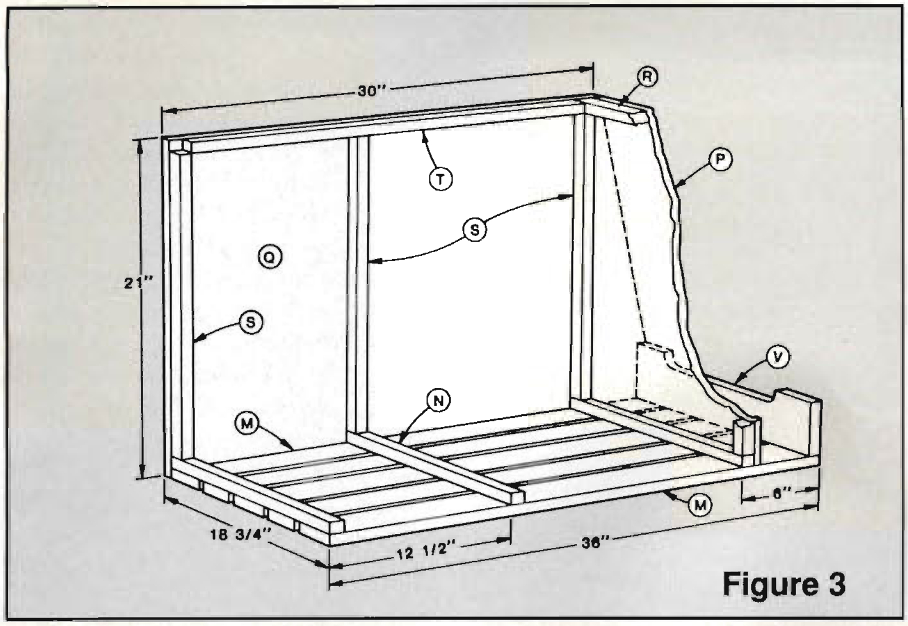
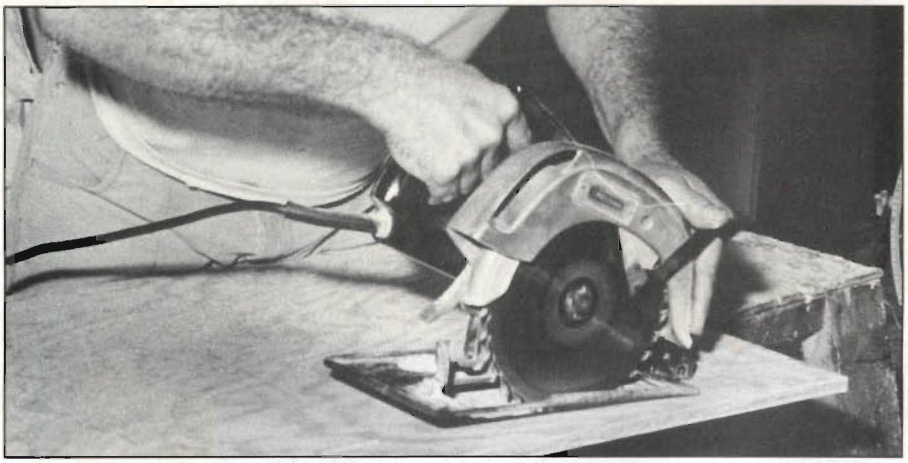


Figure 3

Garden Cart Body					
Cutting List					
		Finished Size			
Qty	**Part**	**T**	**W**	**L**	**Piece**
5	M	3/4"	3 1/2"	36"	bed boards
3	N	3/4"	3/4"	18 3/4"	bottom cleats
1	O	1/2"	18 3/4"	21"	front end
1	P	1/2"	18 3/4"	19 1/2"	back end
2	Q	1/2"	21"	30	sides
2	R	3/4"	3/4"	18 3/4"	end cleats
6	S	3/4"	3/4"	18 3/4"	vertical cleats
2	T	3/4"	3/4"	27 1/2"	side cleats
1	U	1/2"	18 3/4"	19 1/2"	partition
1	V	3/4"	3 1/2"	18 3/4"	tailgate
1	W	3/8"	1"	3"	latch
1	X	3/4"	1"	4"	keeper
1	Y	1/4"	dowel	1 3/8"	latch handle
2	Z	1/4"	9 1/2"	18 3/4"	bin sides
1	AA	1/4"	10"	17"	bin back
1	BB	1/4"	9 1/2"	9 1/2"	bin bottom
1	CC	3/4"	21 1/4"	36 1/2"	top
1	DD	3/4"	2 3/4"	36 1/2"	back rim piece
2	EE	3/4"	2 3/4"	22"	side rim pieces



To cut the door and the bin front out of the side, make plunge cuts with a portable circular saw.

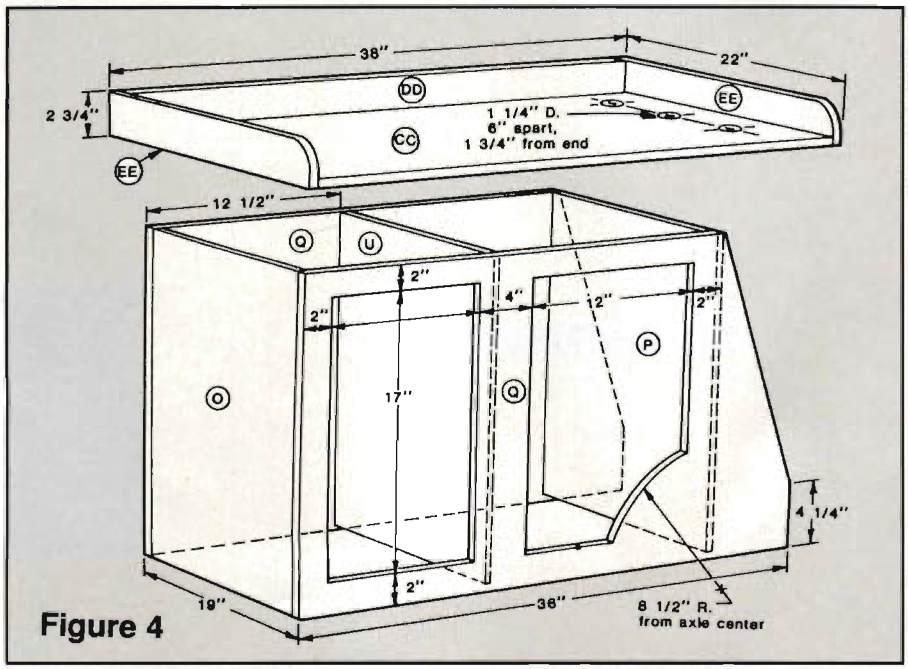


Figure 4

illustrations by Tom Larson

carefully lower the spinning blade into the wood until the base lies flat. Saw each straight line to the corner in this manner, then cut through the corner and cut the curved part with a sabre saw.

Attach cleats to the end pieces (P) first. Nail an end cleat (R) to the top inside edge of each, and attach two vertical cleats (S) so that they butt against the end cleats as shown in Figure 3. Attach the ends to the bed by screwing through the plywood and into the bottom cleats. Now attach the side (Q) that doesn't have doors by screwing or nailing it to the cleats on the end pieces. Position and attach a vertical cleat to this side piece by lining it up to the bottom cleat that's in the middle of the bed. Attach a side cleat (T) along the top edge of the side. Install the partition (U) and then the other side using the same procedure.

Cut the tailgate (V) to size. I detailed

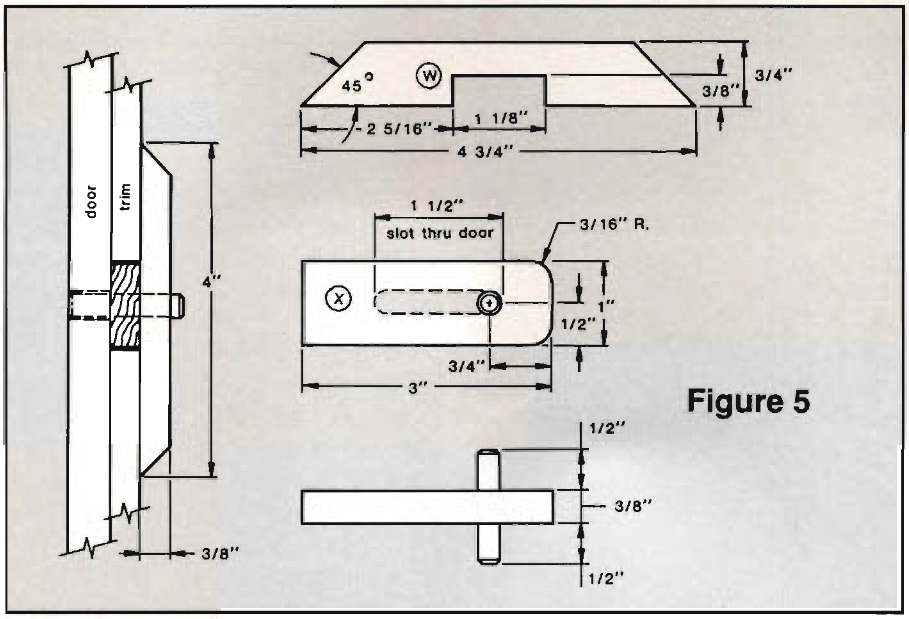


Figure 5

this piece by cutting away part of the top edge and rounding it over with a router. Attach it to the cart by screwing up through the bed and into the ends of the piece.

Sand and stain the body of the cart and the two doors before attaching the trim. The trim is made from 3/8" thick, 1" wide yellow pine. I put trim on the front end of the cart to cover the exposed edges of the plywood. On the doors the trim is mitered and glued to the faces with a 3/8" overhang. Leave a gap in the trim on the left edge of the hinged door and apply a 4" length over it to create a slot for the door latch (W). Fashion a keeper (X) as shown in Figure 5 and attach it to the appropriate place on the body of the cart. Cut a slot in the door for the latch handle (Y) to slide in.

The Bin and the Top

The bin is made of 1/4" plywood and put together with cleats in the same manner as the body. Cut the bin sides (Z) and back (AA) to size. Taper the top edge of the sides from 18-1/4" at the front down to 15" at the back, and cut out the notches as shown in Figure 6.

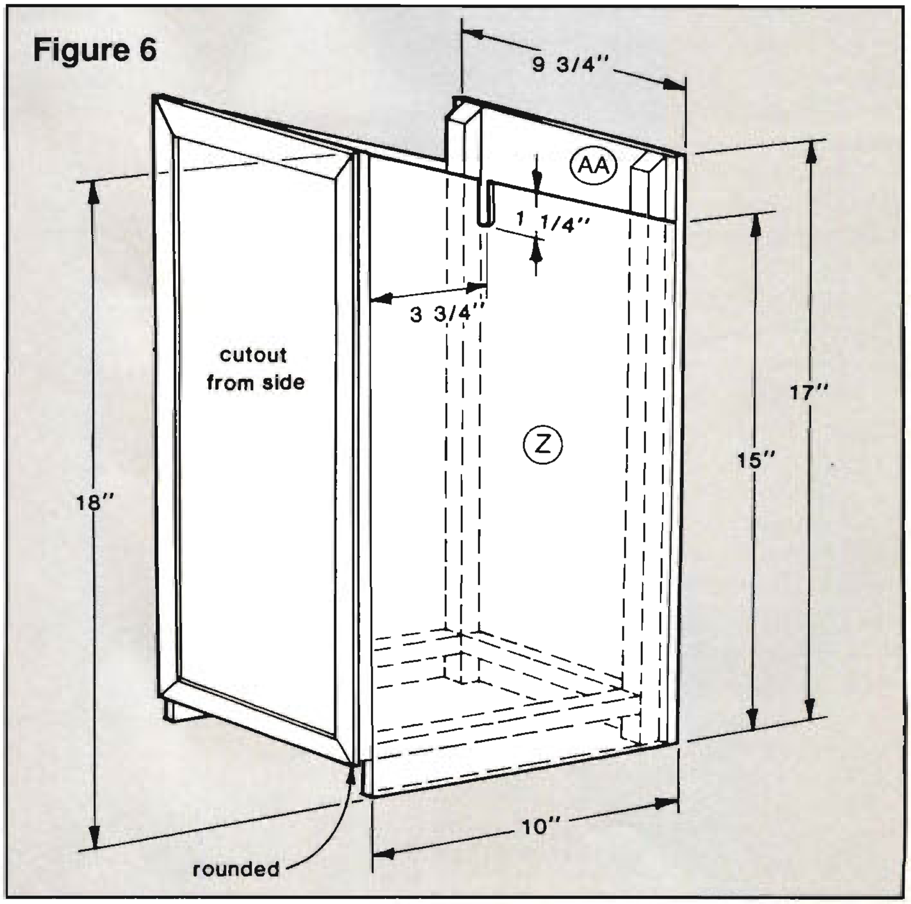
Apply cleats to the sides of the bin and then attach the front (the cutout you made earlier) so it's flush to the top of the sides and 1-1/4" up from the bottom. The back (AA) should be flush to the bottom of the sides and stick up past their tapered top edges (see Figure 6). Also note that the ends of the cleats are bevelled to act as a stop when the bin is tipped open. Notch the corners of the bottom (BB) to fit around the corner cleats and attach it to some cleats running horizontally between them.

The notches in the side of the bin allow it to be slipped in and out of the cart. Push the back of the bin into the opening, then swing the bottom in till it binds. Line up the notches with the top edge of the opening and lift the bin to swing the bottom in and lower it into place. Since the bin pivots on the lower edge at the front, the bottom trim piece needs to be slightly rounded on the inside. Round the edge slightly, then fit the bin in place and try it out. If there is any binding, remove the bin and round the edge some more.

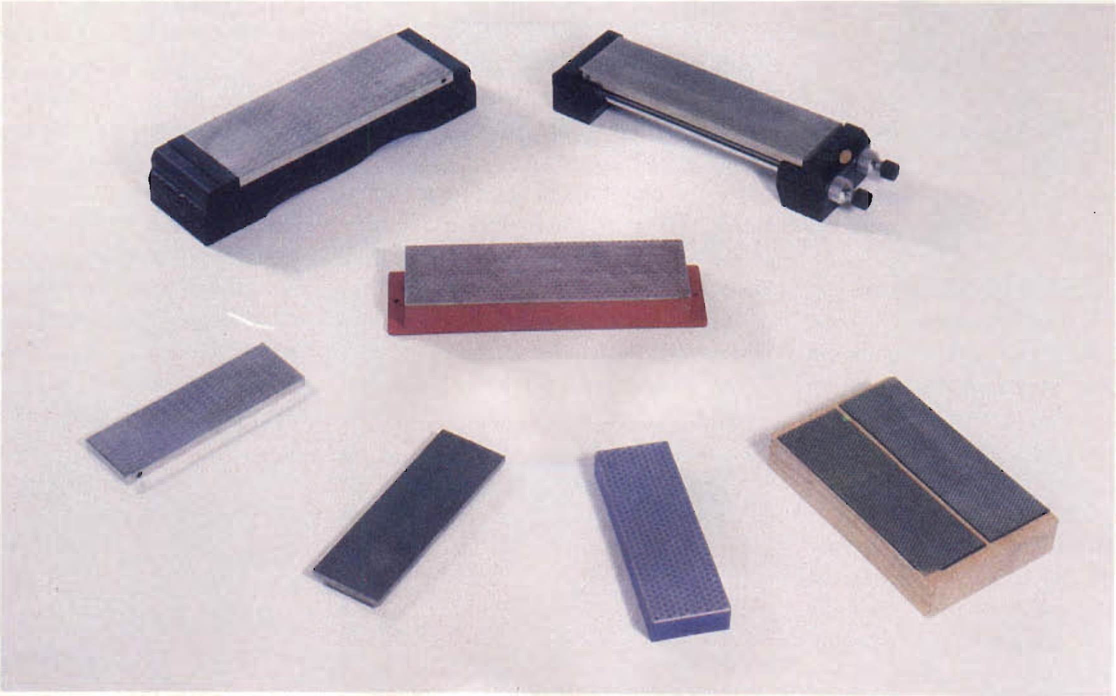
Make up the panel for the top by edge–joining four 38" lengths of 1 X 6 clear yellow pine. Cut the rim pieces (DD and EE) to size, and round over one end of each side rim (EE) (see Figure 4). Attach these three pieces to the edge of the top piece. Position the top so it has a 1" overhang at the front of the cart and a 2" overhang on the front side. Secure it to the cleats underneath with screws that are counterbored and plugged.

Drill three 1-1/4" diameter holes through the top for the shovel, rake and hoe, and drill corresponding holes partway into the bottom of the cart. Attach the door with hinges and apply some sort of handle to the bin (I made mine out of wood). Then give the whole project at least two coats of exterior varnish, and when it's dry, head out into the yard and start digging. PW

Figure 6



Diamond Hones



Clockwise from upper left: Yamaguchi's 3" X 8", 1500–grit hone mounted in a rubber stand; the Tsuboman 2-1/2" X 8", 1200–grit with stand; TBW's 2" X 6" grid and magnets mounted on a wood block; DMT's 2" X 6", 600–grit; Eze–Lap's 2" X 6", 600–grit, the Yamaguchi 2" X 6", 1200–grit; and center: DMT's 2-5/8" X 8", 325–grit.

by Alan Marks

Like many woodworkers, I spent years accumulating what I thought was the finest possible collection of stones for sharpening my chisels and plane blades. Ultimately, I settled on my present collection of three. The first is a coarse carborundum, the second is an unidentifiable mineral stone similar to Arkansas stone (something I picked up in a secondhand shop) and the third is a hard white Arkansas stone for the final edge. I tried and put aside many stones during this process of selection, but still was never entirely satisfied. Sharpening got to be a drudgery I approached with distaste.

During this period of time I saw more and more of my fellow craftsmen switching over to Japanese water stones. They claimed they were quick–cutting and a joy to use. But I noted how rapidly they lost their flatness and (even more troublesome to me) the coarser grit stones had to be kept soaked or in water. I had developed an early philosophy that the fewer pieces of equipment I needed for my work – in this case, flattening plates, carbide powders, and water tanks, the better off I was. So I stuck with my trio of tribulations. I wasn't about to trade one set of disadvantages for another.

Then diamond honing stones appeared on the scene and a ray of hope penetrated the gloom. Diamond hones promised to cut fast and stay flat. They would not glaze over and they seemed ideal for flattening the backs of chisels, plane blades, etc. I decided to try them out for myself as part of my continuing quest for the ideal honing system.

Five manufacturers' hones came under my consideration. Three are manufactured here in the U.S. by Diamond Machine Technology, Inc. (DMT), Eze–Lap, and TBW Industries. The fourth and fifth are manufactured in Japan by Yamaguchi and Tsuboman.

From Dust to Diamonds

In the course of researching this article I learned a lot about diamonds and diamond technology. Everyone knows that diamonds are the hardest substance known to man and also that "diamonds are forever." But not everyone is aware that the diamond particles used today for industrial cutting and honing procedures are industrial products themselves.

Three manufacturers of industrial diamonds market in the United States. These are: Du Pont, General Electric, and De Beers. All three produce the type of diamond used for the diamond honing stones reviewed here. It is a somewhat violent process. De Beers, for example, squashes out theirs in mammoth presses that exert over a million pounds of pressure per square inch (PSI) at a temperature of about 1000° centigrade. Du Pont uses an even more dramatic process. They produce theirs by means of a controlled explosion deep inside a limestone cavern. There a pipe packed with graphite pellets is centered and sealed in a thick–walled metal culvert pipe that is four feet in diameter, with the space between the two pipes packed with high explosive chemicals. On detonation, heat and the enormous pressure of over four million PSI transforms this graphite dust into diamonds in an instant.

Du Pont's diamonds have a particulate **microcrystalline** composition due to the process used to create them. Thousands of microcrystals make up a typical particle of 30 micron size – the size that would be found on a 600–grit stone. Du Pont calls this type of diamond "polycrystalline."

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Monocrystalline diamonds are very different from polycrystalline diamonds. As the term implies, a monocrystalline particle is made up of only one crystal, instead of the thousands of microcrystals bonded together to make up a polycrystalline particle. Another difference is that polycrystalline diamonds are somewhat weaker and pieces can flake off more easily. This ability to flake is called **friability** and is by no means a negative factor.

The only manufacturer I know of who uses polycrystalline diamonds to make honing stones is Eze–Lap. They point out that the periodic exposure of new cutting facets means that sharp cutting characteristics are maintained, much like the way garnet sandpaper works.

The Flatness Factor

Diamond hones, or "stones," as they are referred to by some manufacturers, remain perfectly flat and have a definite advantage over natural stone, carborundum, silicon carbide, or ceramic stones such as those made by the Japanese – all of which require periodic flattening. This brings up a related use for diamond stones: flattening other stones. I experimented with various dished or bellied stones and found that diamond stones do a proper job of it. I found that a medium–grit stone leaves a better surface than a coarse one. It cuts fast and furious and a flattened stone results in no time. For truing a Japanese gold stone I would pick the 2-5/8" X 8" DMT medium–grit hone, but using water doesn't seem all that necessary. For flattening the 800–, 1000– and 1200–grit water stones, water does help.

Flatness is something to be wary of with diamond stones themselves, however. In every case, the diamonds in this sampling of hones are bonded to a metallic substrate, a thick, finely–machined steel plate, with nickel plating or some nickel alloy. The surface in which the diamonds are embedded must be flat to start with because the plating will follow the substrate's contours. Nothing is more frustrating for someone trying to produce a straight chisel or plane blade edge than having a concave or a convex stone.

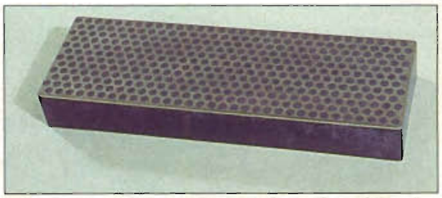
The stones from Yamaguchi are surfaced with diamond dust bonded by nickel–plating to a 5/16" or a 3/8" thick steel plate in a diamond–shaped grid pattern. My samples are dead flat. By virtue of their extreme flatness and very fine grits, they are in a class by themselves. Also, the diamond particle sizes seem to be much more uniform than in most of the others.

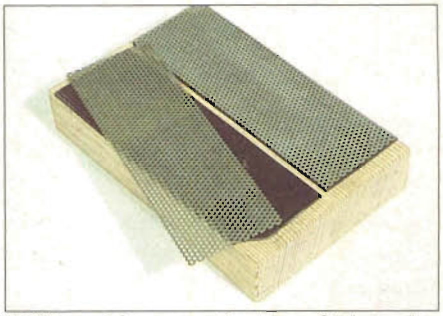
In consideration of flatness, I would be wary when buying stones from DMT and Eze–Lap. I would particularly avoid the stones that Eze–Lap mounts on wood, but I do recommend their unmounted stones. The unmounted ones use a thick steel plate and are impressively flat. DMT is currently working to correct their flatness problem and can supply specially–lapped stones on request.

An important difference between DMT's products and the others is that the diamond surface is plated to a millimeter–thick perforated sheet steel grid which is bonded to a hollow base of reinforced Lexan® plastic, making it the approximate size and shape of regular sharpening stones.

TBW has, in my opinion, an equally clever and certainly less–expensive grid solution. They supply ceramic magnetic strips that are the same size as the grids. When you peel off the protective paper, this strip will adhere permanently to any flat surface, and the thin layer of diamond–coated perforated steel sticks to the magnet. It can be easily peeled off for cleaning the magnet, which accumulates metal particles. In their package you get

Diamond hones excel at flattening the backs of chisels; here, the author is using a Tsuboman 1200–grit stone without a lubricant.


DMT mounts their diamond–surfaced steel grid to a Lexan® base.


TBW provides magnetic strips which can be permanently mounted to a flat surface. The diamond–coated grids stick to the magnet and can be removed for cleaning.

The author uses the 325–grit stone from DMT to flatten a 1000–grit Japanese water stone.

fine and coarse abrasive grids and two sheet magnets, all 2" × 6". At a retail price of $34.95, this is the cheapest way to own two diamond stones for hand tool sharpening.

I would advise a woodworker to plane up a very stable, very flat piece of wood and to mount both magnets and abrasive sheets on it. This way you can be assured of an absolutely flat surface and have both grits immediately accessible. You may want to eliminate the magnets altogether. In trying the TBW set-up I could not get an absolutely flat back on my chisels and plane blades when using a lot of pressure. I believe there must be a certain amount of give in the magnetic material and this is the one drawback to the system. I am sure that eliminating the magnets and bonding the grids to a perfectly flat, hard surface with epoxy cement would solve the problem. The grids cut very efficiently.

Use and Maintenance

One good tool sharpening combination I found was to use a medium and fine diamond stone in conjunction with the very finest Japanese water stone, the "gold stone," which is used for final polishing to a mirror finish. When the gold stone loses its flatness it's a simple matter to flatten it quickly with the medium diamond stone. Unlike Japanese water stones, diamond ones don't necessarily need lubrication. Water is recommended by most manufacturers to facilitate sharpening, but in most cases abraded metal particles do not clog the surfaces even when water is not used.

Diamond hones are also effective for sharpening carbide tools such as this spokeshave blade which is being honed on a Yamaguchi stone.

A note concerning all hones under consideration here: they utilize diamond dust that is nickel–plated to a steel substrate. Nickel is a relatively soft metal. This creates the obvious threat of rust, if and when the nickel plating wears through. Eze–Lap is the only one to my knowledge that heat–treats their plating to greater hardness, and this is only possible because the plating is made from a special alloy.

DMT recommends using water as a lubricant when sharpening. I used their hones to flatten a 1200–grit water stone, neglected to dry the surface afterwards as recommended, and they rusted.

The Yamaguchi hone from Grizzly includes a small bottle of rust remover. They recommend oiling the surface after use with water to prevent rust, which makes good sense to me. Eze–Lap says that lubrication during sharpening is not necessary, though water or oil may be used. TBW says emphatically *not* to use any lubricant with theirs. I found that using paint thinner as a lubricant gave good, rust–free results when sharpening with diamond hones.

TBW is the only manufacturer to actually provide holes in their material for the "swarf" to fall into. Swarf is the slurry of fine abrasive and abraded particles that tends to clog and fill in the spaces between fixed abrasive particles. Unless it is removed, the surface to be sharpened will theoretically glide over these particles and escape abrasion on the cutting edges.

Choosing a Gem

Since diamonds are the hardest substance known, there is little wear on them even when they are used to abrade or shape tungsten carbide. Consequently they can be used for honing tungsten carbide tools. Diamond stones cost two to three times what their counterparts would. Considering that diamonds are "forever," and that they cut about twice as fast as conventional stones, this does not seem exorbitant to me. For the sizes and grits that are available, and also their prices, see the chart on page 57.

As I have said, the diamonds themselves are embedded in a metal matrix, usually nickel. If the substrate consists of a sheet of thin metal with holes in it, you are getting fewer diamonds, perhaps as much as 50% less. At least one manufacturer evaluates his cost in terms of, among other things, diamond carats per square inch of stone surface.

For some applications, a woodworker will need a larger stone than the more or less "standard" 2" X 6" or 2" X 8" one. Actually, in diamond hones there is no *standard*; three of the manufacturers, DMT, Eze–Lap and Yamaguchi, make 3" X 8" stones. DMT also makes a 3" X 12" stone and Eze–Lap will supply one that is 2-1/2" X 11-3/8". TBW will supply custom grids of practically any size.

All three American manufacturers choose 600–grit as their finest. But you can't assume that one manufacturer's 600–grit stone will perform the same as another manufacturer's 600. The Yamaguchi 1200–grit leaves a rougher surface by far than the Tsuboman 1200.

Even after using the finest diamond stone it was necessary to use a hard Arkansas stone, or a Japanese gold stone in order to get an edge to approach what I consider acceptable. My favorite in the 600–grit range is the DMT. It cuts faster than any of the others with less effort. I feel skeptical about some of the advantages they claim about the perforations in their stones, though. It seems logical to me that if you use a perforated grid and sacrifice diamond area you might also get fewer cutting facets per honing stroke. Eze–Lap offers an unbroken surface and I do not find that clogging causes any major problems, except when it's used to true up a Japanese water stone.

For final honing, the diamond stone that put the second best polish on my chisels was the Tsuboman 1200–grit. It comes clamped on a non–slip rubber stand, and it's a honey. My first choice will no doubt come as a surprise; it certainly surprised me. It's the Eze–Lap 600–grit. How can a 600–grit stone leave a better polish than a 1200–grit stone? That requires some explanation.

You see, the polycrystalline diamonds used in manufacturing the Eze–Lap seem to allow it to"mellow" with use. Eze–Lap propounds a unique philosophy: embed your diamonds in a matrix and then let the matrix and diamond wear away together. The company varies its alloy, a combination of four different metals, to enable this. At first the Eze–Lap cut aggressively – like one would expect from a 600–grit stone. Then after heavy use it seemed as if the diamond surface had almost worn out. That was a real disappointment to me because at first it proved to be an extremely fast–cutting stone, and I intended to recommend it as such. I had almost written it off entirely, when I discovered almost by accident that by using it with a lubricant and very light, quick honing movements, it puts a higher polish on an edge than any of the others.

Most people would consider the edge it produces satisfactory, but for the best possible polish it would be advisable to proceed directly from that stone to the gold stone or some other natural stone and get a true lapped finish in no time.

Diamond hones have now replaced all but one stone in my shop. I prefer the one stone to a gold stone since the gold stone rounds over edges slightly, due to its softness. The one survivor from my original trio is my trusty hard white Arkansas stone. Nature still does it best. PW

Manufacturers' Addresses

DMT
85 Hayes Memorial Drive
Marlborough, MA 01752-1892
(617) 481-5944

Eze-Lap Diamond Products
Box 2229
Westminster, CA 92683
(714) 847-1555
–or–
Yale Sales
9400 Bellanca Ave
Los Angeles, CA 90045
(213) 215-3007

TBW Industries, Inc.
Forest Grove Road
Furlong, PA 18925
(215) 794-8070

Tsuboman Co.
2-22-11 Taito
Taito-cho, Tokyo 110
Japan

Yamaguchi Co.
Box 165
Osaka, Nishi, 9-18
Shinmachi, 3-chomei,
Nishi-ku, Osaka 550

Retail and Catalog Sales Outlets

[1]Bob Morgan Woodworking Supplies
1123 Bardstown Rd.
Louisville, KY 40204
(502) 456-2545

[3]Brookstone Company
127 Vose Farm Road
Peterborough, New Hampshire 03458
(603) 924-9541

[1]Constantine's
2050 Eastchester Road
Bronx, N.Y. 10461
(212) 792-1600

[3]Early Winters Inc.
2800 Hoover Road
Stevens Point, WI 54481
(715) 345-2770

[5]The Fine Tool Shops, Inc.
P.O. Box 1262
Danbury, CT 06813
(800) 533-5305

[5]Grizzly Imports
P.O. Box 2069
Bellingham, WA 98227
(206) 647-0801

[4]Hida Tool & Hardware Co.
1333 San Pablo Avenue
Berkeley, CA 94702
(415) 524-3700

[2]Leichtung
4944 Commerce Pkwy
Cleveland, OH 44128
(800) 321-6840

[1]Parker's
Box 24WD46
Wellesley Hills, MA 02181
(617) 481-5944

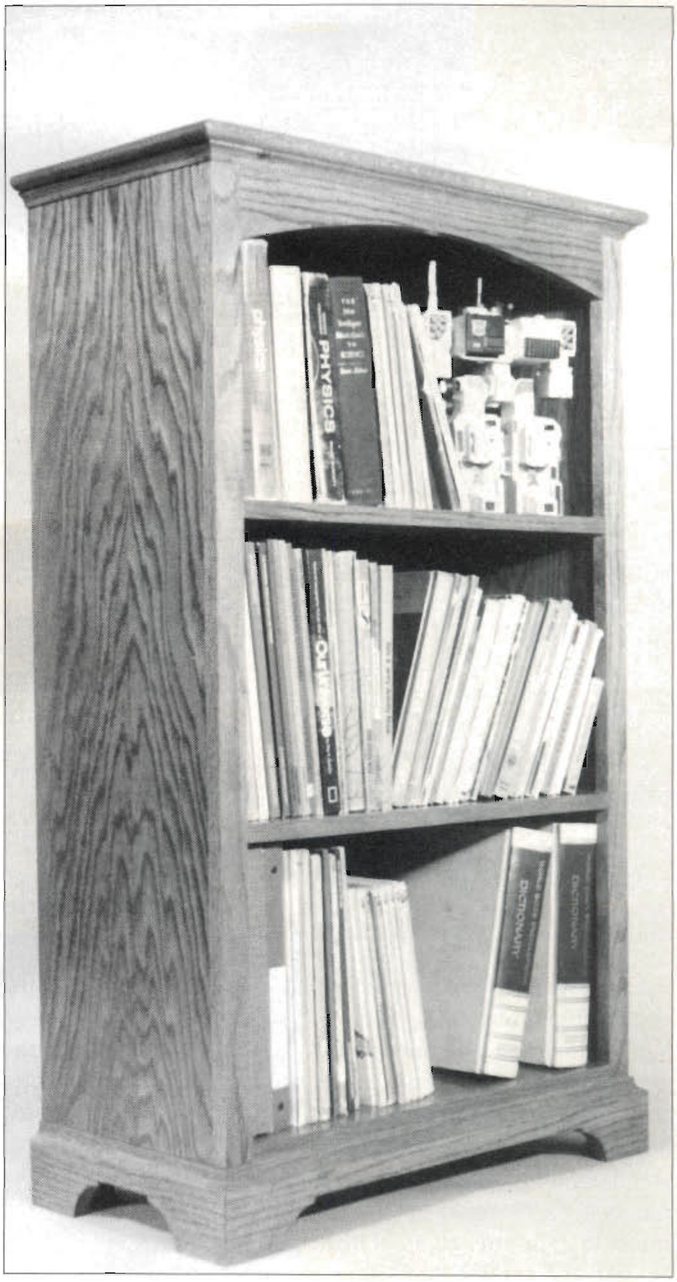
[1,2]Woodcraft Supply Corp.
P.O. Box 4000
Woburn, MA 01888
(800) 225-1153

[1]DMT [2]Eze–Lap [3]TBM [4]Tsuboman [5]Yamaguchi

A Popular Woodworking Project

BUILDING A BOOKCASE

by Mark R. Webster


author

Okay, there aren't any dovetails, steam–bent curves, or inlay, but let me explain. My son came to me one morning and asked if I would build a bookcase for his room (a question I think originated from his mother). I am sorry to say that I'm a lot like the shoemaker whose family goes around with holes in their shoes. In 12 years of avocational woodworking, my quality woodworking has always been for my waiting customers, and there has always been someone waiting. There never seemed to be any time for the family furniture. My first thought was to throw something together out of particle board, buying time until my three boys were older. Later, I would build something out of "real" wood and use "real" joints when the furniture would be better cared for. After I thought about it for awhile, I decided to make something that didn't look thrown together, would be relatively strong, and still not take too long to build.

The resulting plan can extract two cases from one sheet of 3/4" plywood, making it fairly cost efficient. After I built a couple of these bookcases, it occurred to me that someone else might have a similar need. They might also appreciate a design that wasn't ultra–contemporary or colonial.

The first step in making this bookcase is to cut the basic carcase parts: the sides (A), shelves (B), and the top and bottom (C) to size from good hardwood plywood. I don't have a large table around my table saw to allow easy management of large panels. So I usually cut the parts slightly large and finish cut them with the help of a crosscut jig when they are a more manageable size.

Once the panel parts are cut to exact dimension, make the dadoes in the sides to accept the shelves, top, and bottom. Since 3/4" plywood is not really 3/4" but rather 47/64", your 3/4" dado set will be too wide. A solution is to replace one of the 1/8" chippers with the 1/16" chipper and make spacer rings out of paper (a business card works well) or plastic laminate. These rings are placed on the table saw arbor between the chippers and saws of the dado set. Using this technique, you can widen the cut getting just the fit you want.

Another problem encountered when cutting dadoes in plywood is tear–out on cross grain. One solution for this is to use a router with a straight bit. The cure I use (after some helpful advice from a friend) is a wooden insert for the table saw that's used *only* for cutting dadoes to accept 3/4" plywood. The purpose of the homemade insert is to provide support behind the outer veneer fibers so they sever cleanly and do not pull away to produce a tear.

To make the insert, take any 3/8" material (my personal preference is hard maple), and cut it to the same size as your existing insert. Drill a 3/4" finger hole so you can remove the insert after it is in place. Add four sheet metal screws to the underside of the new blank located so they will land on the support flanges in the saw table. With the new insert in place, adjust its height by turning the screws until it is flush with the tabletop. I would suggest making two inserts for this project, one for a 3/4" dado, and one for a 1/4" dado.

Now that "all" the foreseeable dado problems are solved, go ahead and cut the 3/4" wide × 1/4" deep dadoes for the shelves. When you're finished, reset the table saw to cut a 1/4" × 1/4" dado, and cut the groove at each end of the sides for the tongue and rabbet that attaches the top and bottom to the carcase. Notice the fence setting is the same for both ends. The last step is to cut

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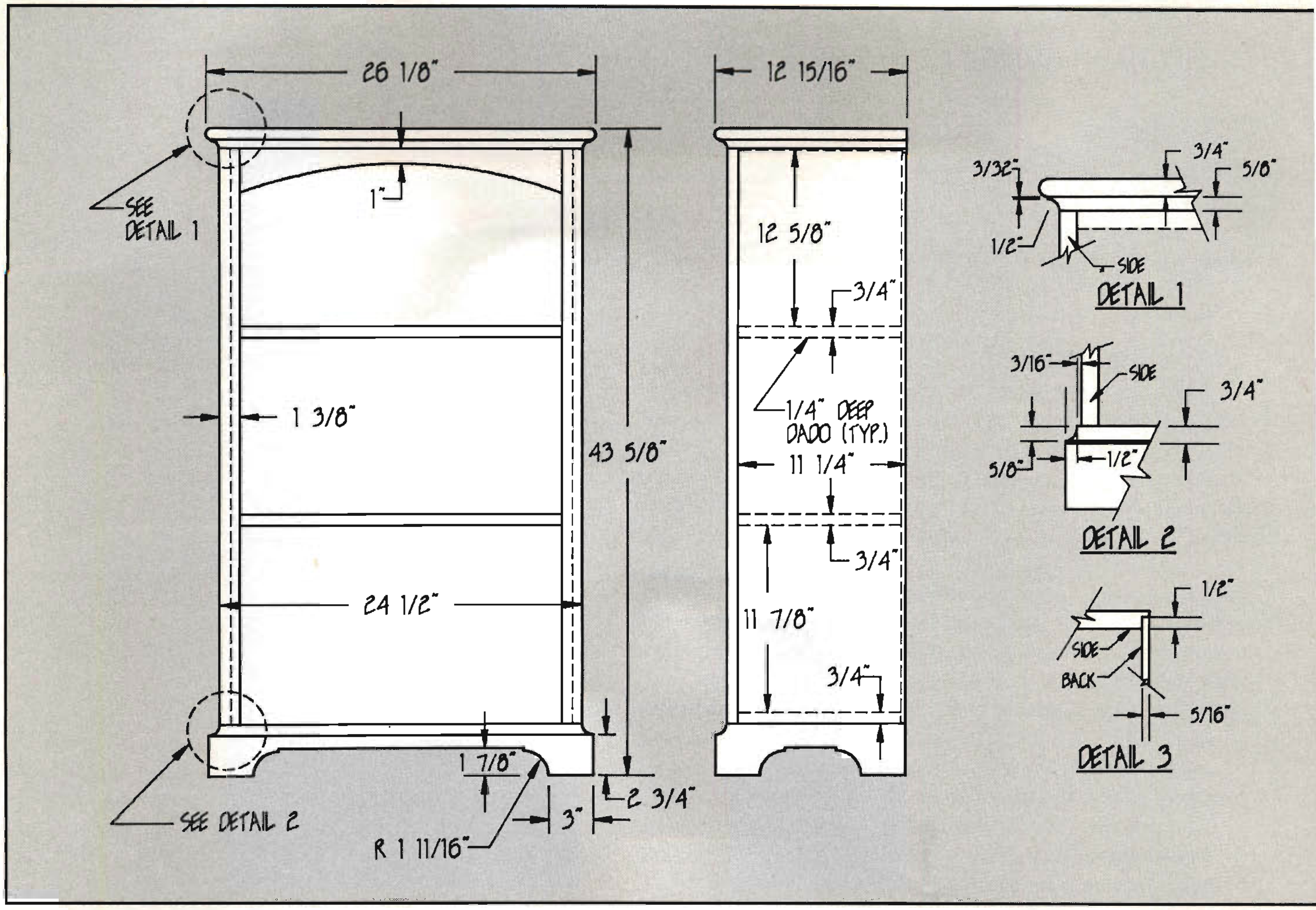
__Mark R. Webster__ is an avocational woodworker and one of the founders of the San Joaquin Fine Woodworkers Association in California.



the 5/16" wide × 1/2" deep rabbet on the inside back edge of the sides to accept the back (D).

After completing the carcase sides, cut the rabbets on the ends of the top and bottom panels making sure to leave enough tongue width to form a tight joint. Be sure you check the joint before glue-up. If the dado is too shallow or deep, or the tongue is short or long, you will have problems. When making the cases for my boys, the tongues were slightly too long, so I used a hand router to adjust the depth of the dadoes.

At this point, cut the back to size and keep it close by; it can be helpful for squaring the basic carcase when gluing. Finish sand or scrape all interior surfaces before assembly. Don't forget to assemble the unit and dry clamp to be sure everything is just right. Assemble the carcase on its back with glue and clamps, making sure the front surfaces are all flush. With everything clamped, raise the case on end and clamp on the back (without glue). If the back fits properly, it should square the cabinet right up.

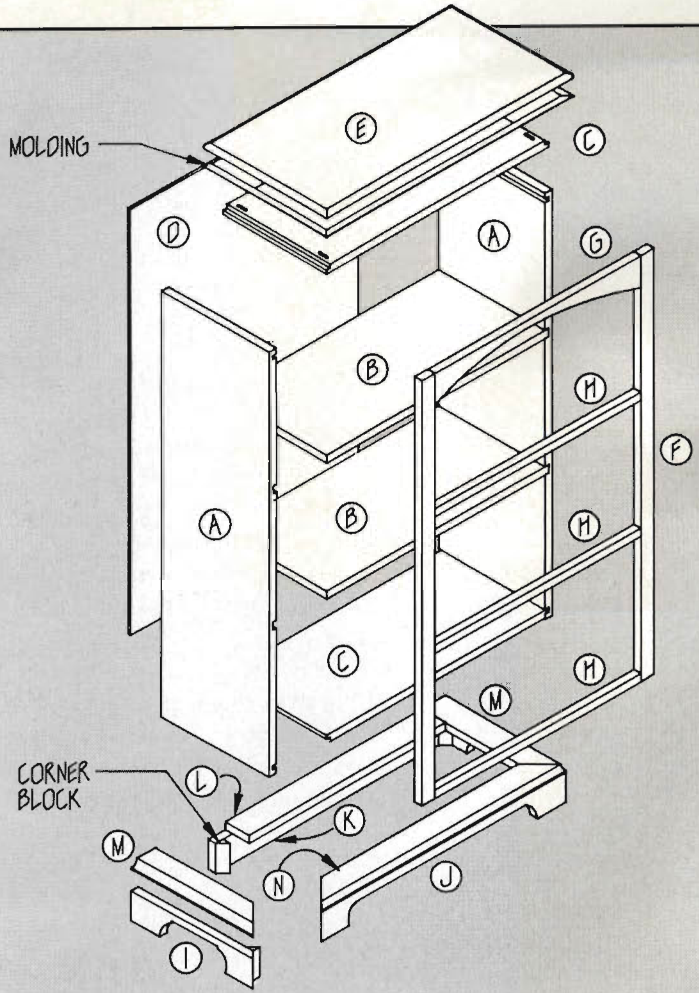
Now turn your attention to the solid wood top (E). Cut enough pieces (a little long) to make up the needed width. Arrange the boards for the best visual effect and, if possible, keep the surface grain running the same direction. Mark a big triangle on the panel so the boards won't get out of order. With this accomplished, joint the edges to be glued and finish fit with a hand plane, planing a slight hollow on the edges to be joined. This increases the pressure on the ends of the joining surfaces, reducing the possibility of joint separation later.

With all the adjoining surfaces prepared, dry clamp and check for gaps. Glue and clamp, alternating the clamps top and bottom. Make sure the panel is flat with no bow or twist from uneven clamping pressure. When the glue is rubbery, scrape it off.

The next challenge is to deal with the panel faces. The bottom surface just needs to be flat, but the upper surface must be flat and smooth. This flattening process can be attempted with a belt sander, but it often requires great patience and occasionally produces dips. I prefer to use a hand plane for this if the wood allows it. I cross–plane at 90° to the grain first, to knock off the high spots. As the board becomes flat, I start planing diagonally with lighter and lighter cuts, working toward final whisper passes parallel to the grain. Here you will appreciate having the surface grain running the same direction.

To dimension the top, rip it a touch wide and follow with a crosscut jig to true one end, then cut to length. Rout the ends and then the front with a roundover bit using a router table and fence. Now, rip the extra width off the back and finish sand or scrape. The top is screwed securely to the plywood top, front, and back. The screws holding the front should be in slotted holes to allow for movement of the solid top.

The face frame is the next mini–project. Cut the stiles (F), top rail (G), and shelf strips (H) from solid wood. Cut the stiles and rails to length exactly, leaving the shelf strips a little long. All of the pieces, with the exception of the top rail, should be left a whisper wide (i.e. a fat 1/64").



illustrations by Jim VanBeveren

Bookcase

Cutting List

		Finished Size			
Qty	**Part**	**T**	**W**	**L**	**Piece**
2	A	3/4"	11 1/4"	39 3/8"	sides
2	B	3/4"	10 15/16"	23 1/2"	shelves
2	C	3/4"	10 15/16"	23 1/2"	top & bottom
1	D	1/4"	24"	39 3/8"	back
1	E	3/4"	13"	26 1/8"	solid top
2	F	3/4"	1 3/8"	39 3/8"	stiles
1	G	3/4"	3"	21 3/4"	top rail
3	H	3/4"	3/4"	21 3/4"	shelf strips
2	I	3/4"	2 3/4"	12 11/16"	base ends
1	J	3/4"	2 3/4"	25 7/8"	base front
1	K	3/4"	2 3/4"	24 3/8"	base back
1	L	3/4"	2 1/2"	20 7/8"	apron back
2	M	3/4"	2 1/2"	12 11/16"	apron ends
1	N	3/4"	2 1/2"	25 7/8"	apron front

You may have wondered if there is an easier way to make an arc other than using trammel points (which most of us don't have) or making squares and copying a pattern square by square. Here is a little trick to produce the arc on the top rail that makes the job a breeze. Cut a strip of 1/4" birch plywood about 1" wide. Now find the middle of the top rail and mark the highest point of the arc. The low points of the arc will be the ends of the board. With the plywood strip on edge, bend it to make a curve that includes these three points, and mark it with a pencil. Sometimes the symmetry is improved if you make half of the curve on a pattern and flip–flop it to mark out the final curve. Cutting the curve on the band saw brings you to the next dilemma: smoothing the resulting cut. You could use a drum sander on a drill press; hand sand with a curved block; maybe even use a spokeshave. My suggestion is to learn how to use a compass plane. The results will be more regular, and if it is tuned properly, you can get an almost finished surface.

After smoothing the inner surfaces of the face frame, it's time to start assembling. Connect the stiles to the top rail with a couple of dowels using a doweling jig (mortise and tenon could be used here). Glue and clamp the three pieces together. With the subassembly dry and the carcase on its back, attach the incomplete face frame with glue and clamps. When this assembly is dry, add the shelf strips (H), making sure the upper surfaces are flush with the plywood shelf surface. These strips are rather small for a dowel, so I just glued them to the shelves and used a butt joint on the ends. If you use this method, be sure the shelf strips fit tightly between the stiles; any gap will show up later. Remove the excess with a hand plane or by scraping or sanding when the face frame is completely attached.

Turning your attention to the base of the bookcase, cut the parts to the exact width, but slightly long. Cut a 45° angle on the ends of the base front piece (I) and on one end of each base end piece (J), then cut the end pieces to length. The base back (K) will be butt joined between the two end pieces. Mark out the decorative pattern; bandsaw and sand the curves and plane the flats. Glue up I, J, and K. Add the corner glue blocks at this point. Now, cut the apron (L, M, and N) to exact size with miters. Dowel the apron back (L) and the apron ends (M) and spline miter the ends to the apron front (N). With this lower subassembly dry, glue and clamp it to the base subassembly. Finish plane, scrape or sand all exposed surfaces, and rout the cove. The base is simply screwed to the carcase through the apron.

The moulding is the last touch. Make the moulding from stock that is 5/8" thick by about 2" wide. Rout the cove along one edge, then rip the moulding to its 1/2" width. Rip it in such a way that the waste is between the blade and the rip fence and the finished cove is outside of the blade. This gives you a little more to hold onto during this step. Cut the miters and glue the moulding to the carcase sides. Do not glue them to the solid top.

With all the construction complete, finish sand the project. Don't forget to soften all edges while sanding. I used three coats of the new Deft Gloss Clear Wood Finish for a finish. PW

Teak

by S. Reed Poverny

Why is teak so precious? You know teak, certainly, if not from its use in Danish Modern furniture, then as decking on ships, veneered wall paneling, or parquet flooring. *Tectona grandis*, as it's scientifically known, is one of the most important timbers on the planet. There are numerous less expensive species sold under the name "teak" – iroko, shedua, and afrormosia among them – but no other wood known possesses the qualities of true teak.

A Malayan word, *tekka*, gives teak its name. Indigenous to India, Burma, Thailand, Indochina, and Indonesia, teak trees also grow on plantations in Africa and parts of South America.

Teak has been widely used in India for over 2,000 years. As testimony to its durability, beams of the wood in temples and palaces in both Burma and India are claimed to have lasted over 1,000 years.

Depending upon where they grow, teak trees vary in height from 50' – 150', with gray bark and straight trunks. Plantation trees are often fluted near the base, limiting their yield for lumber and veneer. The huge egg–shaped leaves of the tree, up to 2' long and 12" across, are so rough–textured the natives use them for sandpaper.

Harvesting teak once involved six years or more before the wood came to market. Since the logs had to become light enough to be floated down river to the mill, the trees were killed by hacking through the cambium layer all around the circumference. After several years of seasoning on a stump, the trees were felled in the dry season and hauled out of the thick forest by elephants. Stacked on the riverbank, the logs would then wait for the rains to flood the river and carry them out. While elephants are still trained and employed for this purpose in Thailand, huge tractors and other modern means are now utilized.

Teak and Boats

In addition to its exceptional dimensional stability, particularly when quartersawn, teak is impervious to termites and resistant to rot and marine borers. Large ocean–going junks were being built of teak in China long before the wood became known in the West. The Chinese would bury the wood to be used for the main mast and spars in wet soil, leaving it there to "harden" for several years, making these members even more resistant to weather and boring insects.

When trade between China and Europe began early in the 19th century, Europe's supply of shipbuilding oak began to wane alarmingly. Teak was found to have properties exceeding even those of oak for this purpose. Similar in strength, it required no paint or varnish to protect it, and the oleoresin it contained prevented corrosion when in contact with iron.

These days, due to the high price of teak, only boats constructed in areas where the tree is native use the wood extensively. Teak has no equal for decking on yachts and ocean liners, but further use is generally limited to trim and interior cabin work.

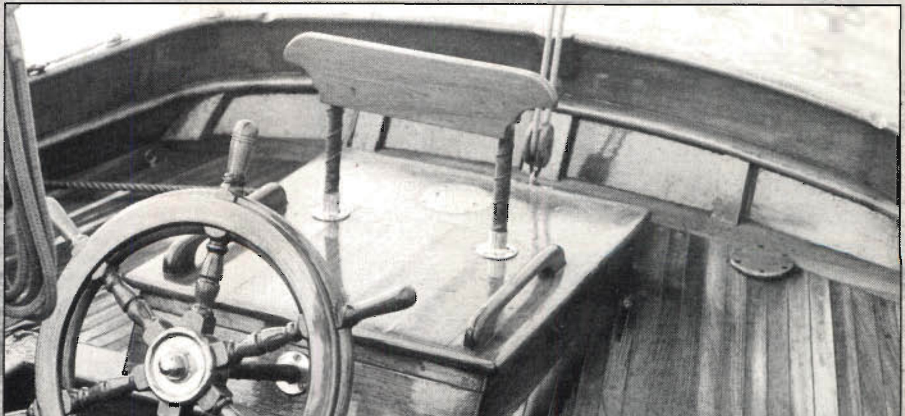
When automobile bodywork was still being framed in wood, teak was selected for vehicles that were to be exported to hot countries. It is still found in outdoor deck furniture and in door and window framing. Resistant to acids, teak is valuable in industrial chemical plants, and for bench tops in laboratories.

Teak enjoyed new popularity as a cabinetmaking wood with the boom of Danish Modern design in the late 1940's. It continues to be prized for fine woodwork of all kinds.

General Description

The light–colored sapwood of teak is susceptible to rot and termites. Durable heartwood is roughly the density and

The sprung deck on the "Nightingale" is unfinished teak. Worn and weathered gray, it contrasts with the varnished teak and polished bronze hardware.The all-teak "Nightingale," owned by David Abrahamsen, is one of four ketches designed by Gene Wells and handbuilt in Hong Kong.



***S. Reed Poverny** is a wood researcher, woodworker and photographer. His work in a specialty lumber store has given him first-hand knowledge of domestic and exotic woods.*

hardness of oak, with a ring porous structure like ash. The wood is oily to the touch, with a fragrance some liken to leather. As with some species of rosewood, teak has a high silica content which appears like tiny grains of sand in the pores of the wood.

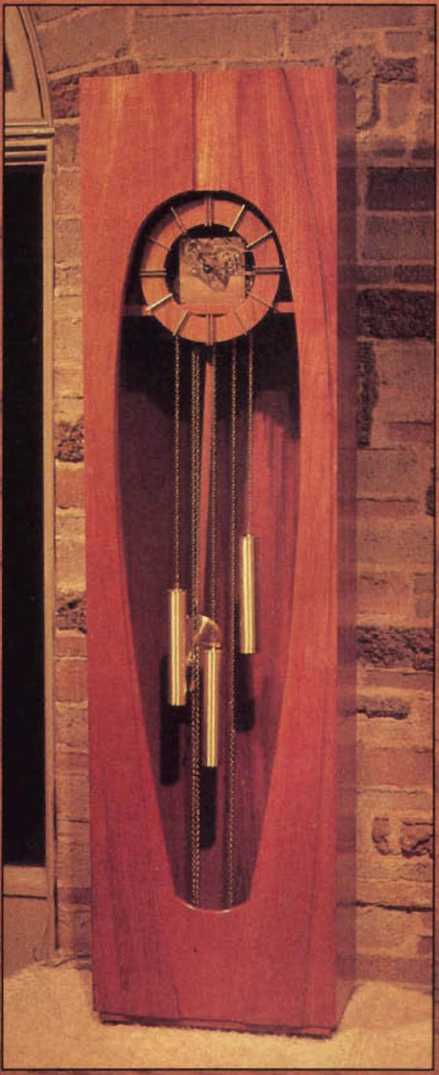
Color in teak runs from gold, to reddish–gold, to brown. Heartwood can be plain or colorful, with contrasting shades of brown and gold. As teak ages, it darkens, and the various colors tend to blend into one. Generally straight–grained and uneventful, teak does, at times, exhibit fiddleback figure, mottle, and even wild patterns. When first cut, the material is pale yellow–green, with prominent black markings and bands of gold, tan, and brown. The momentary drama, however, begins to fade within half a minute as the wood oxidizes.

Plantation–grown teak trees grow much faster than trees from native forests. As a consequence, the wood is lighter in color, less dense, and not as oily. Most of the older, slow–grown teak comes from Burma and Thailand.

Working Properties

The unusually high silica content of teak can dull cutting edges quickly. Turners have even described seeing sparks fly off the ends of their gouges while working teak on the lathe, though it does turn easily. Depending upon soil conditions where it grew, some batches of teak are more abrasive than others. There are craftsmen who find teak no more abrasive than other woods. Boatwright Ron Blair, for example, says, "My machines last twice as long with teak than with oak."

Abrasiveness aside, teak cuts smoothly on a table saw or band saw. Instead of hanging in the air, the oil–laden sawdust settles immediately, clinging to clothing and work surfaces. Blades may become gummy and have to be cleaned occasionally with kerosene. The oil in teak lubricates operations like drilling and routing, leaving behind polished surfaces. The wood yields so easily, in fact, that it seems much softer than it actually is. Teak is a breeze to sand. Not surprisingly, the sticky sawdust quickly fills sandpaper. Sanding to very fine grit is not necessary with this species.



photos by the author

Craftsman David L. Carnesciali harmonizes teak with brass in the graceful lines of this grandfather's clock.

As a carving material, teak has long been valued in the East. Care must be exercised when working the brittle end grain.

Care must also be exercised when gluing teak. The natural resin must be thoroughly cleaned from the surface of the wood with methyl ethylketone or acetone. The surface can be additionally roughened to improve adhesion. Then a resorcinal glue or slow curing epoxy is recommended.

Finishing

"Danish" oil, like that applied to Danish Modern furniture, is a simple and effective finish. Varnish, the traditional finish for teak on boats, is another alternative. Getting the finish started is difficult. While older, drier teak accepts varnish without a fuss, the oil in fresh teak seems to reject it. Considerable effort may be required to fill the pores and achieve an acceptable build–up. Unfinished teak decking on boats is sometimes maintained with soft soap. The wood is first scrubbed across the grain using a soft brush. To avoid wearing the wood unnecessarily, only the final strokes are made with the grain. The gray surface that forms on raw, weathered teak protects the wood beneath.

Availability

While the worldwide demand for teak surpasses supply – thus affecting its price – the wood is readily available in the form of lumber, veneer, and veneered plywood. Some years ago an embargo was placed on teak from Thailand, but this has since been lifted. According to one large wholesaler, whose main business is selling teak to the marine trade, "We can get all we can sell."

Standard thicknesses are 1/2", 4/4, 5/4, 6/4, 8/4 up to 4" with widths averaging 6" – 12". Lengths are up to 20'. Boards are consistently straight and clear. The price is about double that of American black walnut. Lower priced teak shorts, about 4' in length, are also available.

So why is teak so precious? The full answer is to be known through experiencing it. PW

A Handsome Mirror Frame

photo by the author

by Hugh Foster

I made this attractive mirror to complement the tall pecan chest that was featured in *Popular Woodworking* Issue #39 (October/November 1987). Making it requires some extra care and introduces you to cutting mitered dovetails.

While the first step is to gather your materials, I would caution you to buy your mirror *after* your inner frame is assembled—just to make sure you have a good fit.

Start by making the inner frame. As you'll note in the cutting list, the inner frame top and bottom (A and B) are short wide pieces with the grain running in the same direction as the inner frame sides (C). Of course, you could glue up a solid 29" X 39" panel and cut out a 23-1/2" X 29-1/2" opening in the middle, but, unless you can use the piece in another project, that would waste a lot of wood. Making pieces A, B, and C separately is more economical, but then the question is: How do you glue up wide short pieces and have them come out flat, smooth and square? I made mine as extra length on the panels for a larger project and then cut them off to the proper length.

I cut the 1/4" X 1/4" rabbet on the back of these pieces before gluing them between the inner frame sides (C). Make sure you have a square fit, then glue and clamp them together (but don't pull the joints too tight). After you have cleaned up the glue, rout in the rest of the mirror channel and square the corners with a chisel. Now your 24" X 30" mirror should fit.

Cut the frame top and bottom (D) and sides (E) to size. Mark out and cut dovetails just as you would in any other project—with one slight difference: instead of cutting off the full shoulder next to the first tail and leaving the whole first pin, cut *both* at a 45° angle so the front edge of the frame is mitered (see detail A

***Hugh Foster** is a part-time furniture designer/builder in Manitowoc, Wisconsin.*

Handsome Mirror Frame

Cutting List

Qty	Part	Finished Size T	Finished Size W	Finished Size L	Piece
1	A	3/4"	23 1/2"	5"	inner frame top
1	B	3/4"	23 1/2"	4"	inner frame bottom
2	C	3/4"	2 3/4"	39"	inner frame sides
2	D	3/4"	2"	30"	frame top & bottom
2	E	3/4"	2"	40"	frame sides
1	F	1/8"	29 1/2"	39 1/2"	back
Supplies					
1			24"	30"	mirror

in the illustration). For this to look right, the first cheek on each piece should not be cut down to *both* scribed shoulder lines, but rather from the outer corner and down to the shoulder line on the inside surface. This isn't as difficult as it sounds, but do cut the miter carefully; if you're 1/64" too short you've created a piece of scrap and get to start over with a fresh piece of wood.

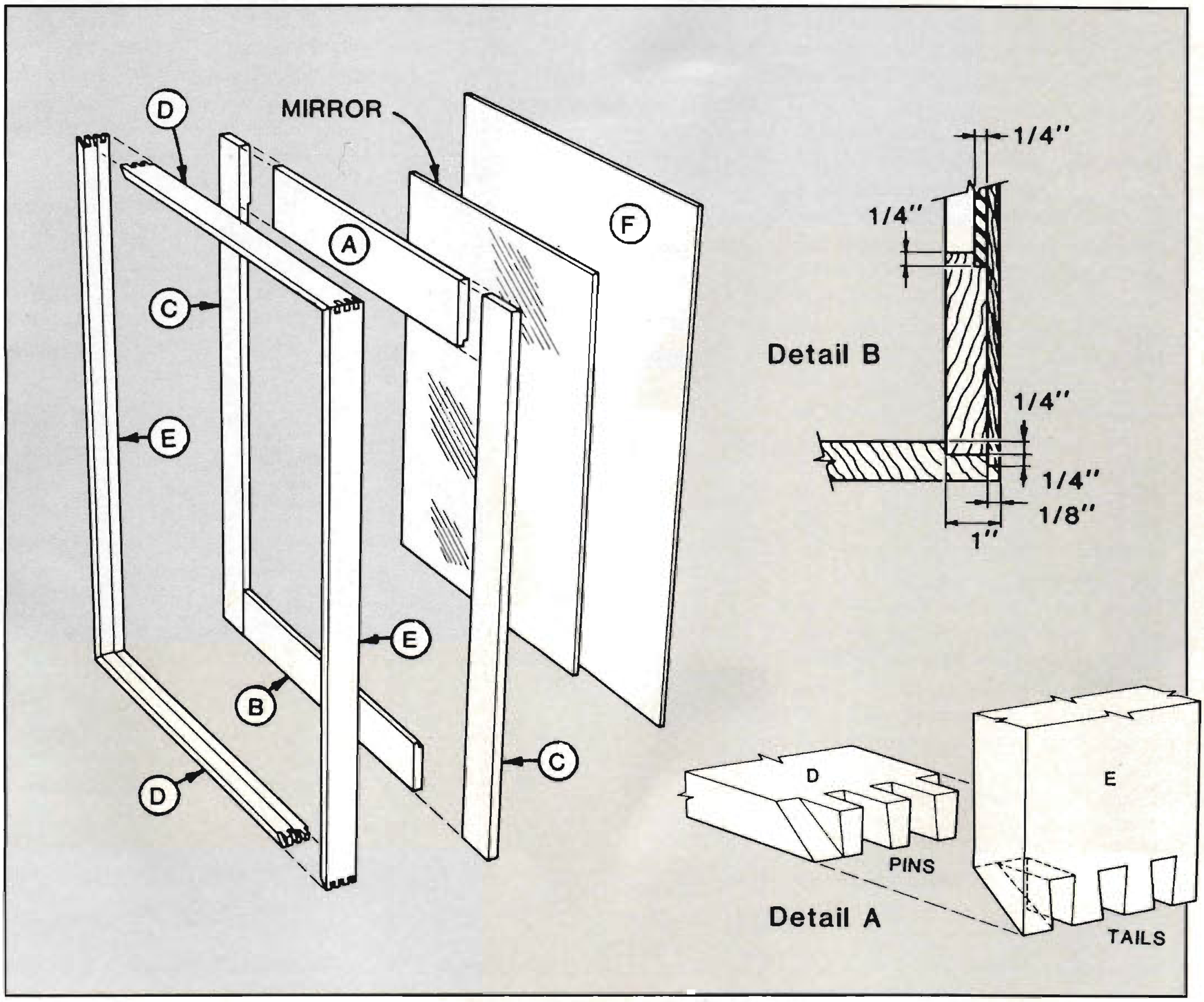
Of course, you could always just miter and spline these corners, but if you're practiced at dovetails, why not challenge yourself to go this one step further?

The inner frame rests in a rabbet that is cut deep into the frame. It is held in place by the back (F) which sits in a shallower rabbet. Put the frame together and rout in a 1" deep × 1/4" wide rabbet at the back of it (make several passes). Now rout a second rabbet into the remaining 1/2" thickness of the frame (see detail B). This way the inner frame can "float," thus avoiding expansion and contraction problems.

Sand and finish the inner and outer frame before assembling. Be sure to put finish on the back of the inner frame in the mirror channel, because the mirror will reflect this surface.

Mount the mirror loose enough to allow the wood to move with the seasons. Secure it in place with glazier's points. Then set the inner frame into the outer frame, again allowing a loose fit. Make the back (F) from medium–density fiberboard (Masonite®) and glue it into its rabbet without getting glue on the inner frame.

Apply hanger brackets and wire to the back of the mirror and hang it from a heavy–duty hook set into a wall stud. Then step back and make sure you look as good as the finished product. PW



illustrations by Tom Larson

Workshop Organization Ideas

by Paul Mason

You say your shop is growing ever smaller, and now you have to go outside to turn around? Or maybe you spend hours on your hands and knees looking for just the right wood scrap that's hiding underneath the workbench with the mice and sawdust? If the pack rat syndrome has you infected, and your tools, hardware, and wood are scattered, wedged, and piled everywhere, then maybe it's time to organize.

Some of our readers have sent in tips on how they solved their storage problems. What's good to know is that most of these projects can be made from scrap wood. So dig through those piles one more time and get organized.

Against the Wall

Not only do woodworkers stack and store scraps, we also shove and balance our tools in the only available places left. Many times, these aren't very convenient or safe spots. Most of the shops I've been in store their pipe clamps haphazardly, standing them on end in a corner or dangling them dangerously from assorted hooks.

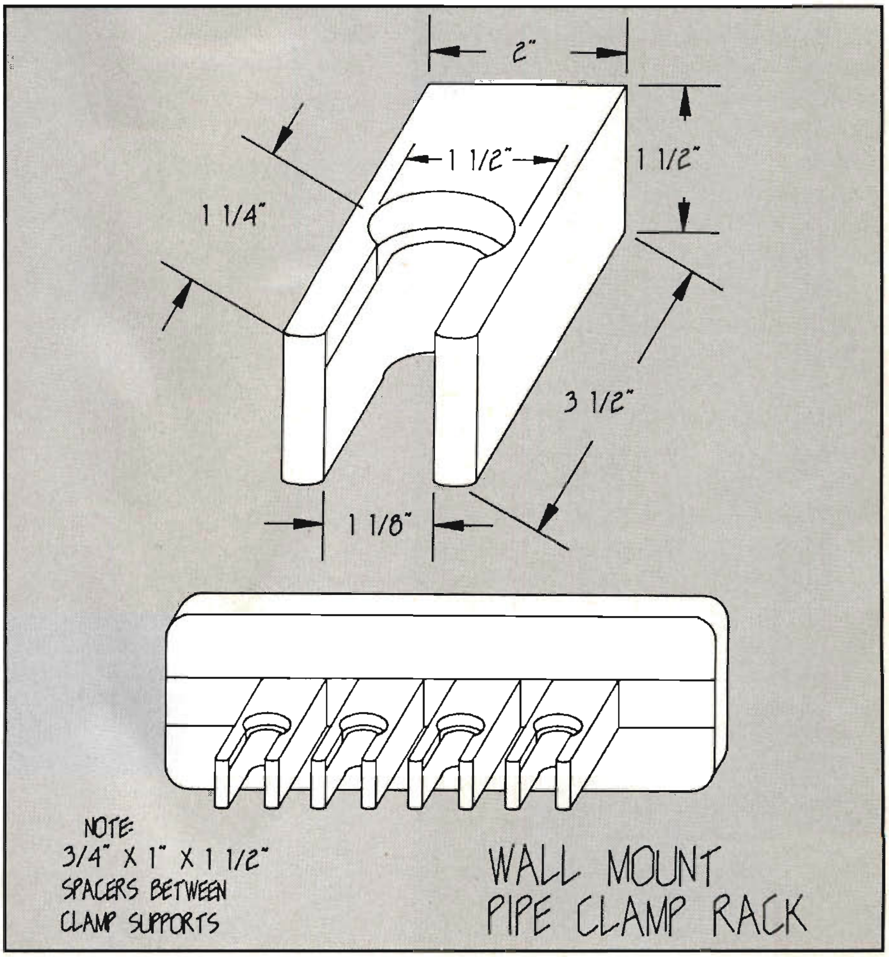
Jerry Ernce from Broken Arrow, Oklahoma has come up with a safe and handy rack to store his clamps. Instead of having to wrestle a pipe clamp out from the others each time one is needed, this rack holds the bars separately from one another. And be assured no matter how often you bang or back into them, they will stay put.

The rack can be individually tailored to suit any shop because you make as many supports and separators as you have pipes. The supports should be made from pieces of hardwood 1-1/2" thick × 2" wide × 3-1/2" long. Cut them to size and mark a front edge for each support. From that edge, measure in 1-1/4" on center, and drill a 1-1/2" hole 3/8" deep. Finish drilling the rest of the way through with a 1-1/8" bit. From the front, cut into each support to the 1-1/8" hole leaving a 7/16" thick wall on each side. Select from your scrap box enough stock to cut 3/4" thick × 1-1/2"wide × 1" long pieces to separate each pipe support. Also cut two end caps 3/4" thick × 1-1/2" wide × 3" long.

Lay all this out starting with an end cap, then a support, a separator, another support, etc. until the last end cap. This will give you the overall length of the project, which is the dimension you need to cut a top and bottom cap, each 3/4" thick × 2" wide by however long your project is. Glue the supports and separators between the top and bottom caps as shown, and finish as desired. Mount as high as needed, centered on two wall studs. Be sure and use screws that are long enough screws to carry the load the rack is to support. Always add a few extra supports in hopes of an increasing clamp inventory, and hang the extra lengths of pipe which can be supported by their unions.

To use this rack, the pipe clamps must be in the closed position. Note that removing the clamp from the rack will require a 3/8" lift before coming out; this keeps them from falling out.

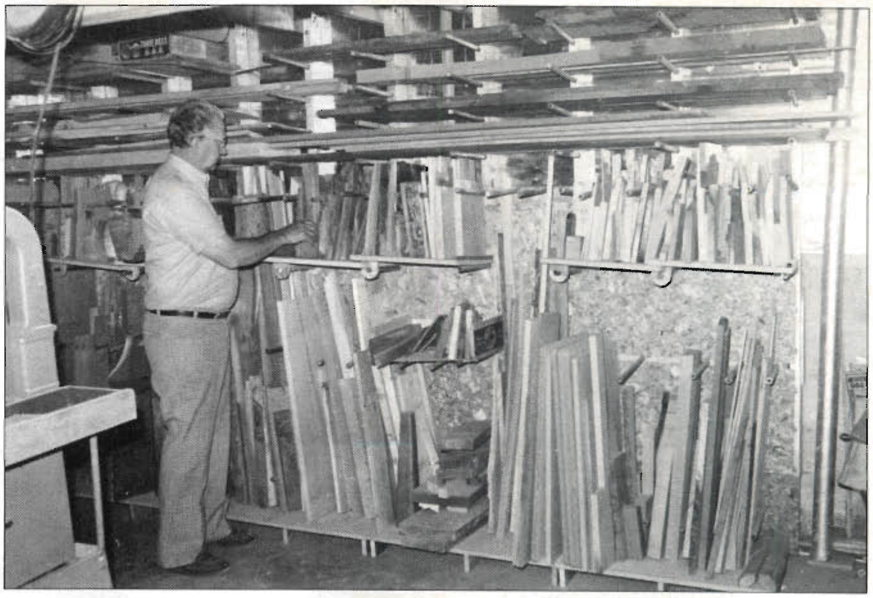
illustrated by Jim VanBeveren



NOTE:
3/4" X 1" X 1 1/2"
SPACERS BETWEEN
CLAMP SUPPORTS

WALL MOUNT
PIPE CLAMP RACK

Paul Mason is associate editor of Popular Woodworking.



Short Stock Convenience

Alice and Robert Tupper from Canton, South Dakota organized their scrap pile using an unused wall to store cutoffs in the shop. Their wall rack stores a variety of wood sizes and lengths of pipes and slanted shelves. The system is made of 2 × 4's that have 1/2" pipe set in the edges at an angle to support the shelves and long stock. Their 2 × 4's are bolted to the ceiling joists; if you have exposed studs in your shop, you're a step ahead.

The 4' or longer material lays lengthwise across the upper 1/2" pipes. Pieces 18" or less stand on the slanted shelves. (The shelves themselves are made from sink cutouts that the Tuppers purchased very cheaply.) The slant is to the right and back, keeping the wood leaning against a sheet of 1/4" chipboard that's nailed to the 2 × 4 uprights. Cutoffs 18" to 26" in length sit on the lower shelf. A few spaces were left for narrow strips up to 5' that are too small to use and too good to throw away.

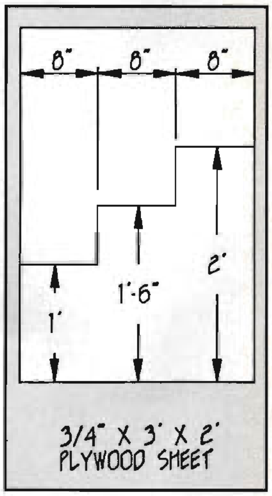
This storage arrangement makes it possible to find a piece of material just the right size without searching through an unreasonably large pile.

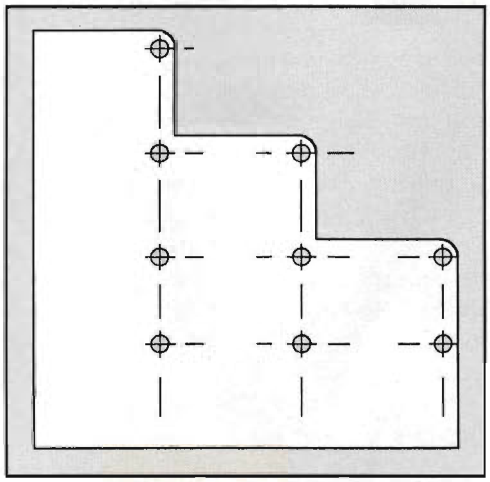
Dowels and Rods

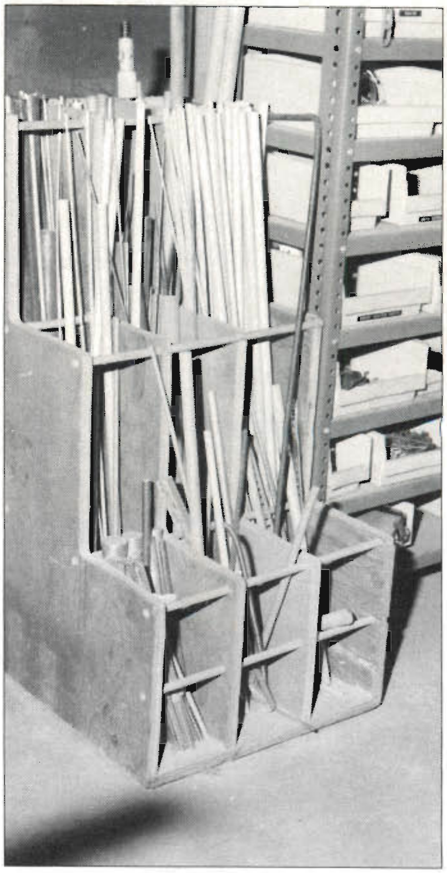
Hugh Williamson from Tucson, Arizona has come up with a way to end that continual search–and–grab method used to find the right dowel. This rack organizes assorted stock for easy selection by separating nine compartments into three different height levels with four 3/4" plywood panels.

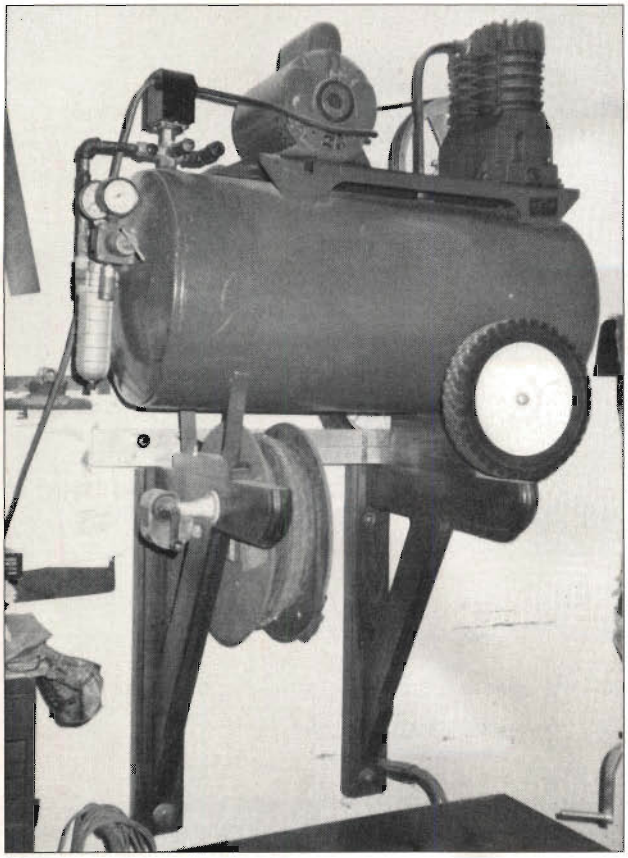
Start by cutting the four panels, back and bottom to size from 3/4" plywood. If you feel the need for an extra strong rack to hang on a wall, then cut dadoes in the back and bottom for the four panels. Otherwise, butt joints are strong enough for a free–standing unit. Stack and fasten the panels together temporarily with nails or tape, then lay out the holes for drilling using either a 3/8" or 1/2" bit, depending on the diameter of the dowels you're going to use for the spacers. Make sure they move easily through the holes. Round any sharp corners at this point if you like.

Push the dowels through the panels, then attach the back and bottom with glue and nails. The trick to securing the dowels is to push them into position without any glue, then back out about 1/2" and apply a band of glue at the four glue points as you rotate the dowel. Keep turning the dowel while inserting it into position. Make sure to scrape off any excess glue. A few coats of tung oil makes a serviceable finish.









In the Air Air Compressor

If you have it, you wouldn't do without it. But that big air compressor takes up precious floor space, and if you have a small shop, every inch counts. Jerry Ernce took on the problem of clearing some floor space by rearranging some wall space and racking up his compressor. With this design, the compressor can be removed from the rack and set back on its wheels with a minimum of effort and no modification.

First, locate two studs that have an electric outlet nearby. Use 2 X 4's or whatever else is handy in the scrap box that is strong enough to make the supports for the compressor. These plans are specifically designed for a 30–gallon tank with motor and two lung compressors, which seems to be the most popular model for small shops and home craftwork. Check to see if your model will fit these dimensions. If not, adjust accordingly. Cut your stock and fabricate the mortise and tenon joints as shown. Make sure the joints have a good fit and as-

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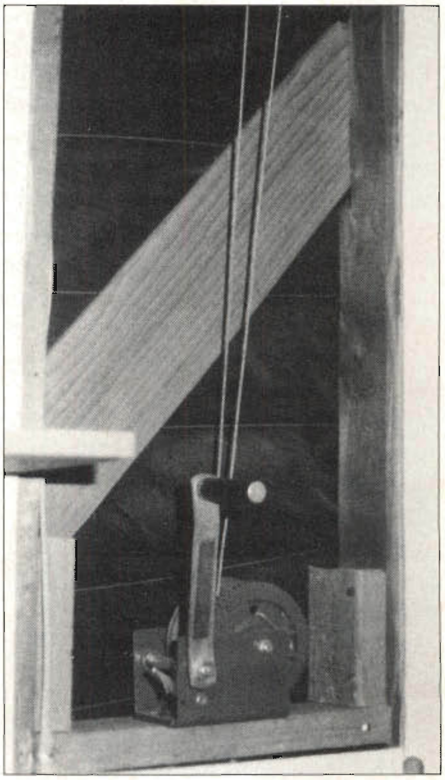
Up, Up and Away

Racking up something on a wall is one way to manage unused space, but Martin Zschoche of Vista, California has gone above that – way above. Zschoche's shop uses a lot of veneer, much of it purchased in full 10' and 12' lengths. Not wanting to roll it up, he began eyeing that 3'X 12' X 8" deep space above the open garage door and below the rafters. So, he built a pine storage box to hold his full–length veneer and rigged a winch–and–cable system to utilize a relatively useless space where everything could remain flat, undisturbed, and be quickly retrievable.

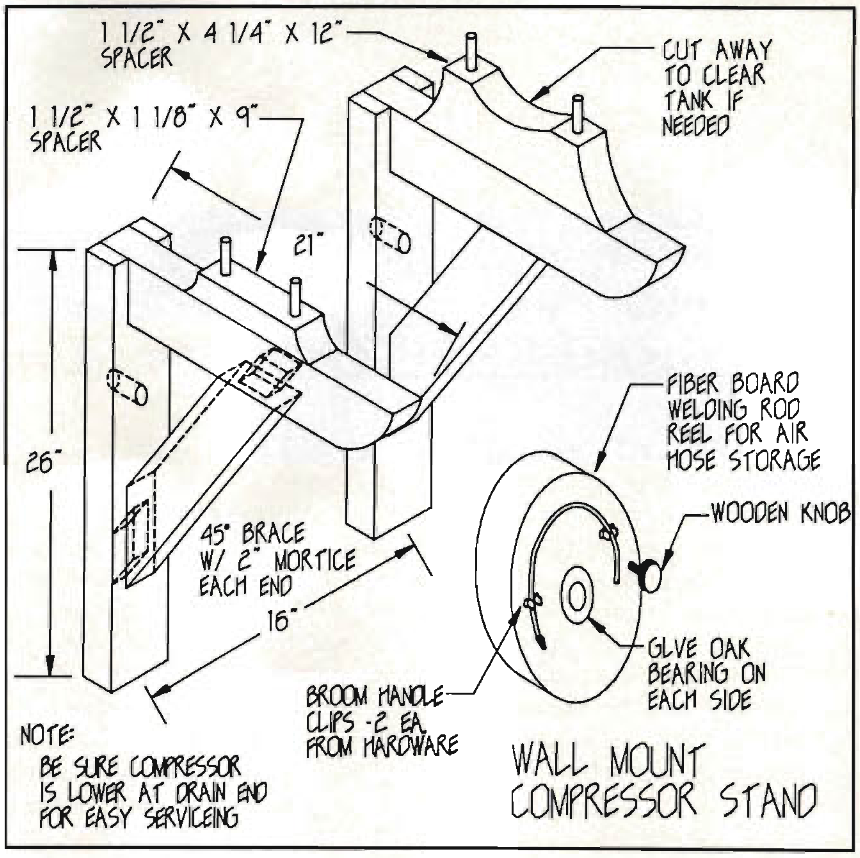
The bottom of the box is constructed using three 12' long 1 X 12 pine boards, joined together by 1 X 2 *battons on two–foot centers.* 1 X 8 sides and ends were screwed to the bottom board and at each corner. The box is raised and lowered by a series of 2" pulleys, 1/8" braided cable, and a hand winch. The pulleys above the box are anchored with lag bolts to the rafters to allow for clearance of the cable yoke and connectors. Two more pulleys are anchored to the side walls of the garage and the winch is anchored to a 2 X 4 fire block in the wall. He recommends that you reinforce the fire block used to anchor the winch as there is a tremendous amount of stress on very little wood.

The cable is strung with a supporting line at each end of the box, so it raises uniformly and lies flush to the rafters. As a safety factor, the cable is continuous and makes a loop at the winch. The ends of the cable are looped through holes on the sides of the box near the ends, pass underneath the bottom, and are clamped back onto themselves with two cable clamps each. You will need to work at adjusting the cable lengths so the box lies evenly against the rafters.



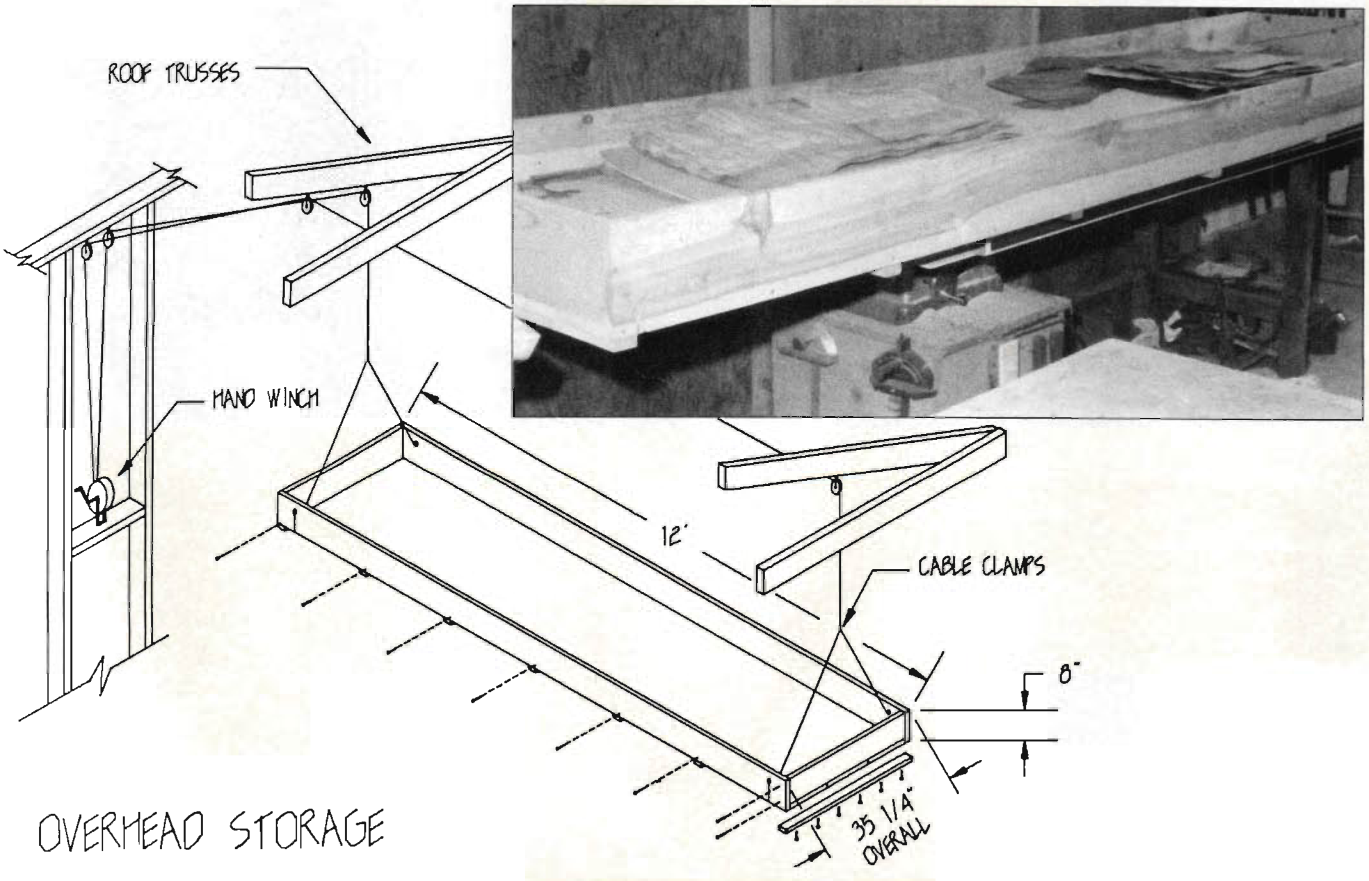
semble with yellow glue. If you're feeling particularly crafty, dress the rack up with some router work and stain it to match the other cabinets in the shop.

The rack has two hanger bolts in each riser that secure the compressor to the supports by fitting into holes in the compressor's legs – you may have to drill your own holes and space the bolts as necessary. Large rubber washers or strips of felt under the legs will deaden most of the vibration. If you leave enough of the hanger bolts exposed, you won't need nuts to fasten down the legs. Anchor the unit to the wall between the two studs using large washers and 4-1/2" or 5" lag screws on center. If you stop by your local welding shop, most of them have small welding rod reels that are normally thrown away; they'll hold about 50' of air hose. One or more of these can be mounted under the rack to keep the hose rolled up neatly. Be sure the air compressor is lower at the end with the water drain petcock for easy servicing.

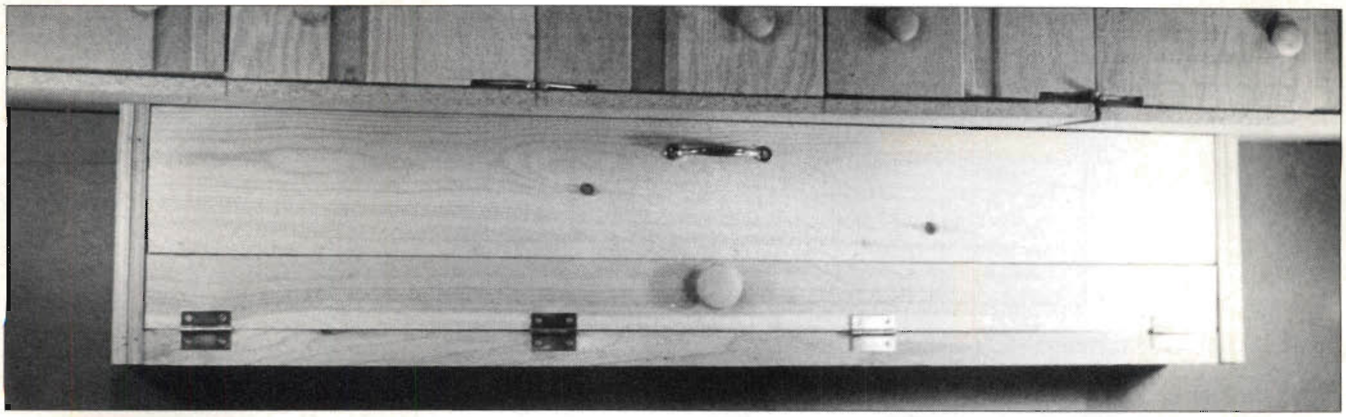

1 1/2" X 4 1/4" X 12" SPACER
CUT AWAY TO CLEAR TANK IF NEEDED
1 1/2" X 1 1/8" X 9" SPACER
21"
26"
FIBER BOARD WELDING ROD REEL FOR AIR HOSE STORAGE
WOODEN KNOB
45° BRACE W/ 2" MORTICE EACH END
16"
GLVE OAK BEARING ON EACH SIDE
BROOM HANDLE CLIPS -2 EA FROM HARDWARE
NOTE: BE SURE COMPRESSOR IS LOWER AT DRAIN END FOR EASY SERVICEING

WALL MOUNT COMPRESSOR STAND

Illustrated by Jim VanBeveren



OVERHEAD STORAGE



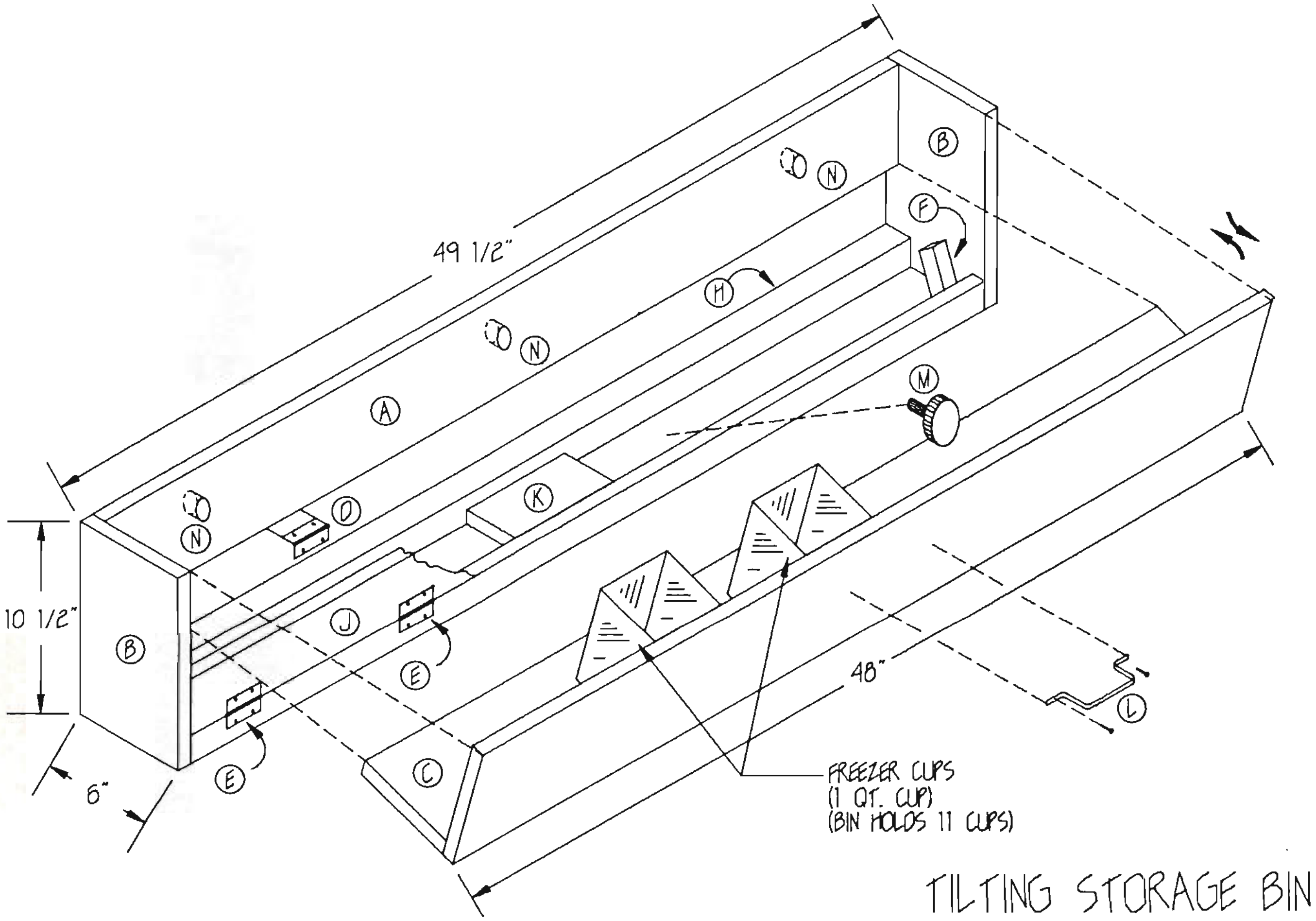
Freeze Those Nail Problems

If your shop is anywhere close to average, then nail storage is probably a frustrating problem. Hunting through paper bags and looking for misplaced jars is tedious and time–consuming. This simple, tilting storage bin designed by Merton Slutz of Chattonooga, Tennessee will bring those problems to an end. The bin is designed to store freezer cups (quart size: 4" X 4" X 5") which hold the nails on an "L"–shaped tilting shelf. The nail bin measures 49-1/2" long and can hold 11 cups. The unit is designed to be mounted up under shop storage cabinets, where it's out of the way yet easily accessible.

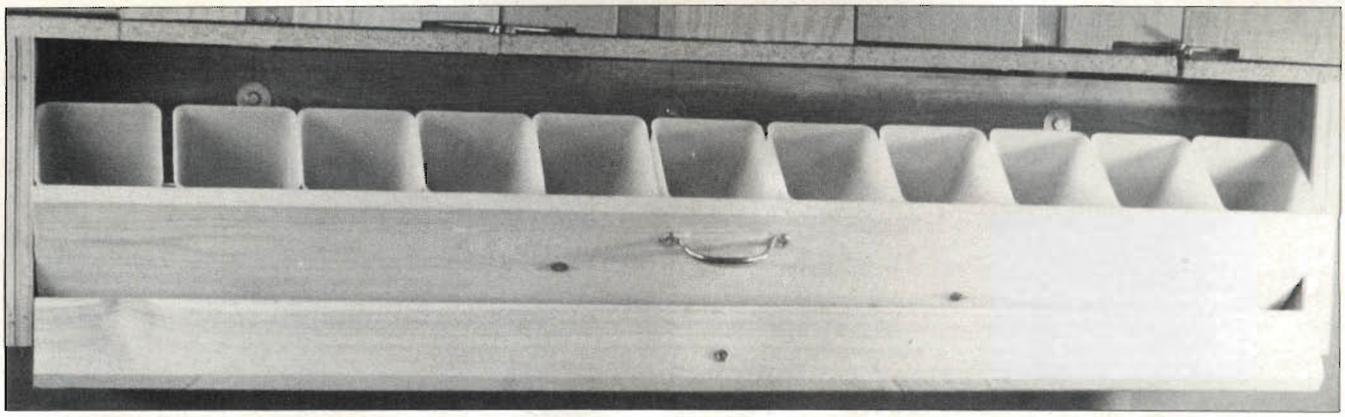
The bin contains a hinged lower board which, when swung down, allows the bin to open about 45°, exposing the freezer cups. To operate the tilting bin, simply hold the bin handle, swing the lock board down, and ease the bin into place until it rests against the stop cleats.

This bin will not only hold nails, but any small part as well. Any commercial service shop could use the bin for storage of repair or sales parts. Should your workshop not contain wall–hung storage cabinets, mount the bin along any wall. In fact, if you need more storage area, build a series of bins and stack them over each other on a convenient wall surface. Start the first at eye level and stack downward, unless you don't mind using a ladder to retrieve the cups.

The bin can be cut from 3/4" plywood or solid stock. The



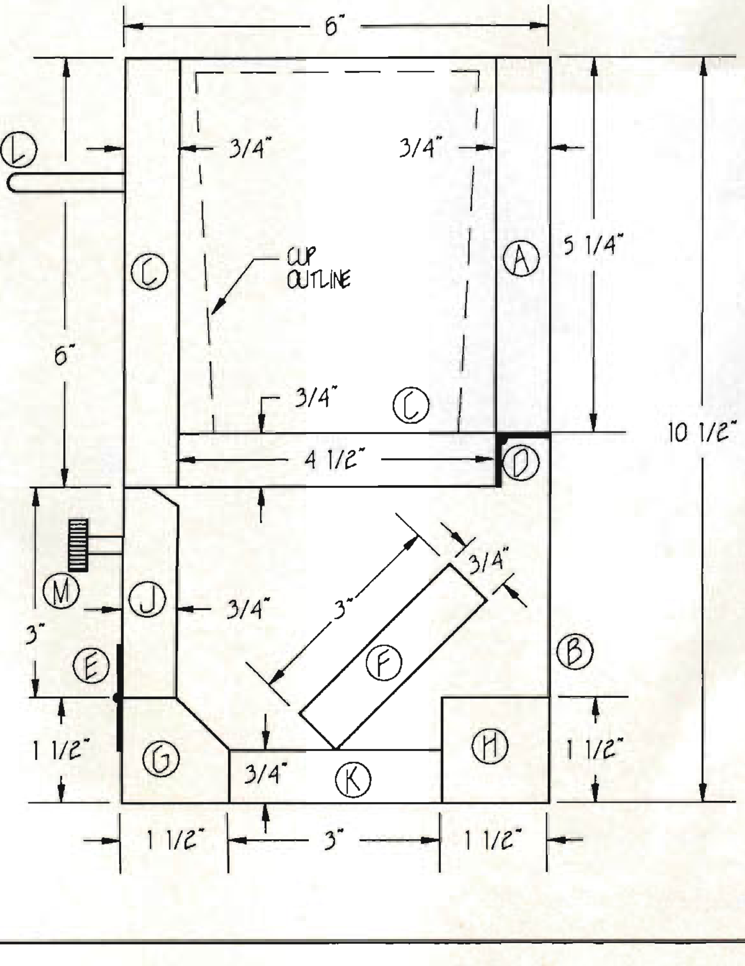
TILTING STORAGE BIN



model shown here by Mr. Slutz is made of western cedar and spruce scraps. Begin by laying out and cutting the two tilting bin pieces (A and B). Use straight boards which will not interfere with the hinging action. Butt joints with screws or glue and nails will make a satisfactory "L" bin. Next, make the cabinet which holds the tilting bin. After joining the cabinet ends (C) and the mounting backboard (D), attach the four hinges and then secure to the tilting bin. With the three cabinet pieces together and the tilting bin operating, it becomes easier to check the proper angle and clearance for placement of the stop cleat (E). When attaching the stop cleats, make sure that the stop position is adequate for easy cup insertion and removal. The bottom 1-1/2" square hinge brace (F) is beveled along its length on the inside edge to allow clearance for the tilting bin when opening.

Attach the bottom back brace (G) and the center brace support (H) as shown. Cut out the lock board (I), beveling the top rear edge. This bevel allows the board to swing down without hitting the tilting bin. Use four hinges for the lock board. Attach the handle and pull knob to the bin and lock board respectively.

Anchor the unit to wall studs with washers and 1-1/2" or longer lag screws inserted through the mounting backboard. If the bin is not mounted directly under an existing cabinet, it will be necessary to attach a top piece to the cabinet ends and backboard. Some 3/4" door trim on the exposed edges will add a finishing touch. **PW**



Nail Bin

Cutting List

Qty	Part	Finished Size			Piece
		T	W	L	
1	A	3/4"	6"	48"	bin front
1	B	3/4"	4 1/2"	48"	bin bottom
2	C	3/4"	6"	10 1/2"	cabinet ends
1	D	3/4"	5 1/4"	49 1/2"	mounting board
1	E	1 1/2"	3/4"	3"	stop cleat
1	F	1 1/2"	1 1/2"	48"	bottom hinge brace
1	G	3/4"	1 1/2"	48"	bottom back brace
1	H	3/4"	3"	10"	center brace support
1	I	3/4"	3"	48"	lock board

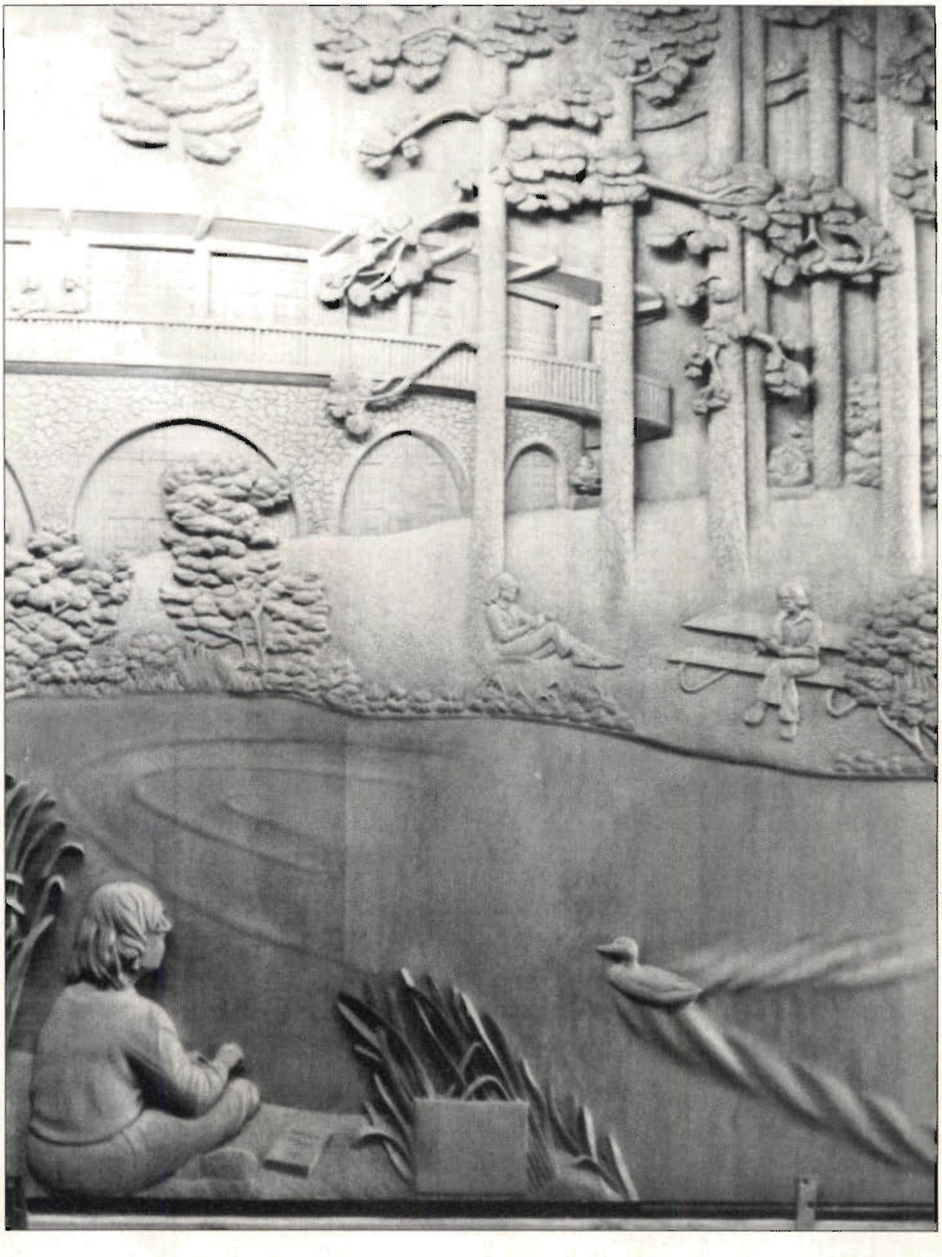
Supplies

1	handle
1	pull knob
8	hinges
11	one-quart freezer cups

illustrated by Jim VanBeveren

Focus on Carving

Relief Carving - The Final Touches



photos by the author

by William H. McMaster

For the past several issues, I have been using my carving of the Columbia Panel to illustrate the techniques for relief carving a nature scene. In the finished carving here you can see the overall effect created by the detailing we shall discuss in this article.

I like to carve the final touches with a small #3 gouge mounted in a dowel rod so that it can be handled like a pencil. You will find that this style of gouge gives you the most control for carving fine details. I use a full set of such gouges ranging from 1mm to 6mm in width. Note that the panel is almost vertical while it is being carved. This is harder on the arms, but has the advantage that you can step back frequently to observe what you have just carved. This helps solve problems of perspective and lighting that could not be seen properly if the panel were horizontal. Because of the shadow pattern, you can clearly see the convex shape of the ground in front of the building as described in the article on depth perspective ("Relief Carving: The Illusion of Distance," *Popular Woodworking* Issue #40, December/January 1988).

The effectiveness of detailing is extremely dependent upon the effects of light and shadow. Make a cut and the shadow it creates reveals its shape. Study the shadow carefully and use it to determine how the next cuts are made. Thus the carving is **iterative** since each cut affects the next one. The way the texturing is done depends upon the effect created by the previous cuts. The carver is using his own creative ability to represent a scene rather than making an attempt to reproduce one.

The article I referred to above discussed the use of perspective to provide the illusion of distance in a carved scene. This carving uses a variation of the laws of perspective known as **universal perspective**, which means a representation of a scene does not necessarily have to use just one principal vanishing point. When actually viewing a scene in nature, such as the one recreated in the Columbia Panel, your line of sight *moves* from

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***William H. McMaster** is Chief of the Education Division of the California Carvers' Guild. His "Focus on Carving" is a regular feature in* PW.

looking down at the near shore to upward at the distant trees. This action was simulated in my carving by using two views merged into one, looking down at the lake, and horizontally at the far shore. The principal vanishing point for the upper half of the carving is located just below the two figures on the balcony. It was marked on the rough carving and used to establish the angle of the roof rafters.

Trees and foliage impose special problems in relief carving since there are so many details it would be impossible to capture them all. Therefore, study the scene first to remove all insignificant details, and focus on those aspects that give the impression you wish to convey. You must select those elements which best help to express the idea behind the scene you are carving. Some of them will be stressed by emphasis, others included with less detail, and some will be omitted altogether. A work of art is not supposed to be a direct copy of nature but a representation through the artist's own personal interpretation. I will discuss the methods and techniques I used in designing and carving the details in the Columbia Panel.

Much of the detailing in this carving involves foliage in the trees and bushes around the main administration building of the college. When looking at foliage of any kind, a carver must identify the dark and light areas. Photographs – especially black and white photographs – of the foliage will greatly help you in this analysis. Learn to see nature as regions of light and dark, and not as a number of separate objects independent of their surroundings. The openings between clusters of foliage help explain the growth of the branches that support them. These openings vary for each type of tree and bush and help us to recognize the species. Thus you should carefully follow nature's design in your carving.

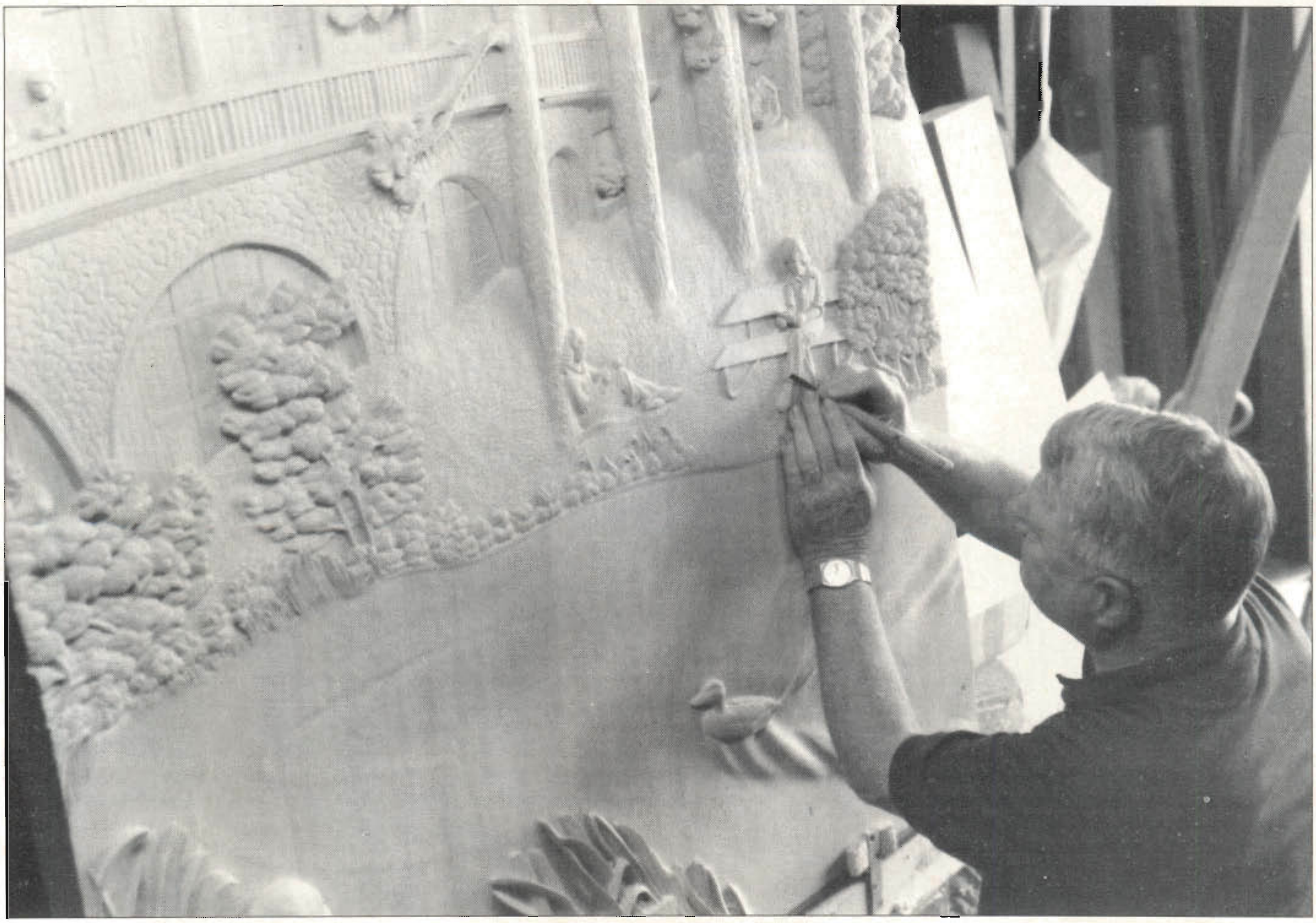
Carving the Trees

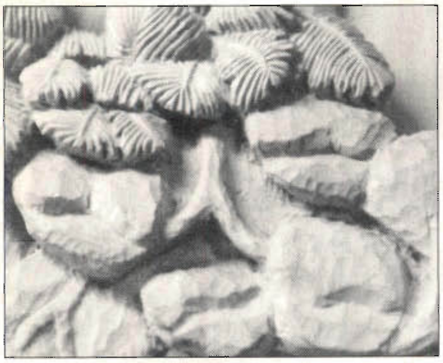
A carved scene should not be a census count of all the trees and bushes. Provide just enough detail to suggest the essence of the subject. Take a look at the forest near the building which is to be the center of interest for the Columbia Panel. In the real scene there were many more trees present which, if included, would have detracted from the rendition of the main building. I eliminated the trees directly in front of the building to give a better view and simplify the scene.

The trees in this scene are pines which are straight and tall. The foliage is relatively narrow, and the branches have a tendency to droop. There is a lot of open space between the branches, permitting much of the sky to be seen through the trees. Before carving the trees, analyze the basic structure and decide upon the techniques to use to give the visual effect of realism.

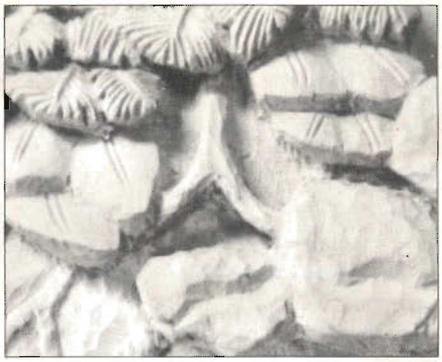
In the article on depth perception I mentioned that one of the visual cues for interpreting distance was focus. The most details will be on the trees nearest to the viewer. Note that the tree behind the building has no detail; it's shaped to give just the vague impression of a pine tree in the distance.

The author carves the details with tools mounted in dowel rods so they can be handled like a pencil. The panel is set up vertically so he can step back and study it as he carves.

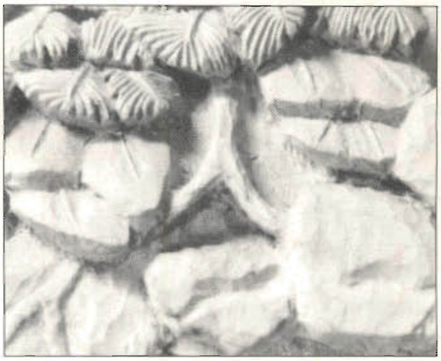




First, create the surfaces on which to carve the pine needles.



Smooth the surfaces, and outline the ribs that support the needles.



Shape the surface around the ribs to create a rounded plane for the individual needles.

The Pine Needles

Pine needles from this region appear as a series of radiating lines from a central rib, grouped in small clusters with lots of open space in between.

The series of photographs above illustrate the step–by–step process of carving the clusters of branches and their needles. The first photograph shows the definition of the clusters and their supporting branches. The surfaces are carved relatively smooth before beginning the detailing. The purpose of this step is to provide the basic form upon which the details can be added.

The second picture shows the step of defining the ribs that support the growth of the needles. I sanded the surfaces smooth and then used a V–tool to outline the ridges. I've found that it's best to do detailing on a smooth surface. It better defines the texture and helps you to visualize the steps you are going through.

In photograph three I have used a #3 gouge to shape the surface around the central ridges and to make the ridges rounded. This creates a slight depression which will add curvature to the needles. Remember: there are no flat surfaces in nature.

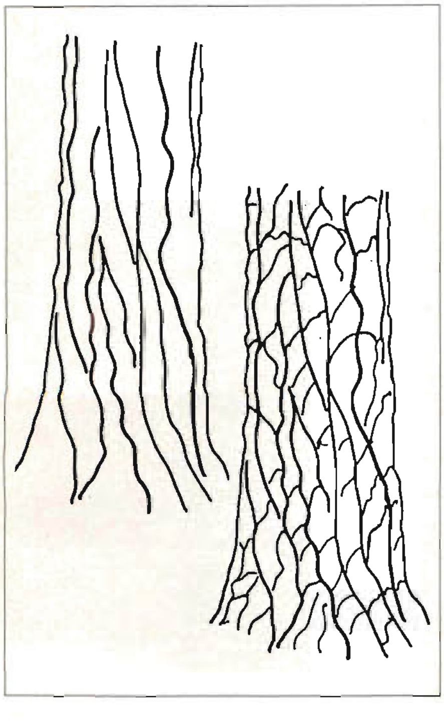
The next step shows the cuts used to give the impression of pine needles. These were made with a small V–tool that has a sharp V–edge at the bottom and very thin wings. I used a Japanese tool whose very thin blades give a knife–like cutting action. These small cuts could also have been made with a small skew, but it would have taken more effort.

The final step is to add some irregularity to the edges by removing a needle here and there to create splits in the pattern. This is similar to carving feathers to make them look more realistic. Do not do too many of them, just enough to give the impression. Also undercut the needles at this time to provide a stronger shadow pattern, and then notch between the needles to produce an irregular profile.

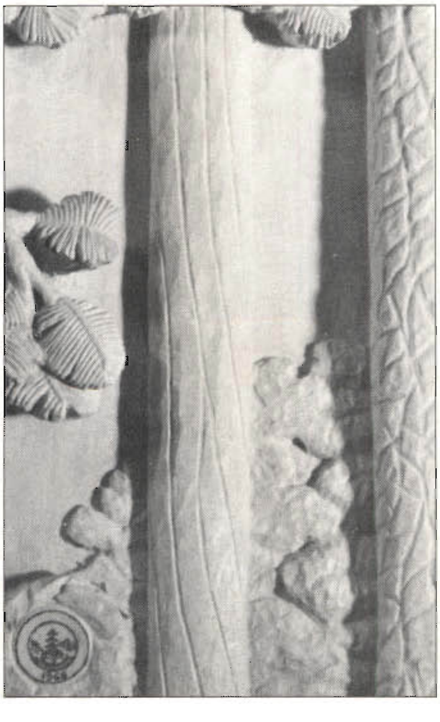
The Tree Trunks

Before detailing the tree trunks, they must be properly shaped. From the principles of foreshortening ("Relief Carving: The Illusion of Depth," *Popular Woodworking* Issue #41 February/March 1988) we know that the cross section must be ellip-

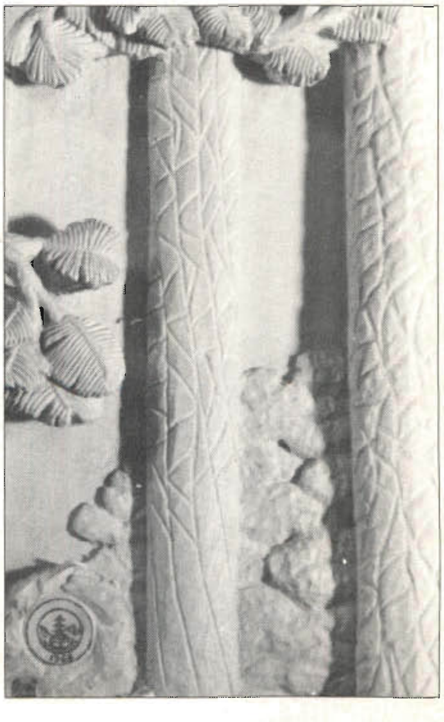
***Figure 2.** Sketch analysis of tree bark*

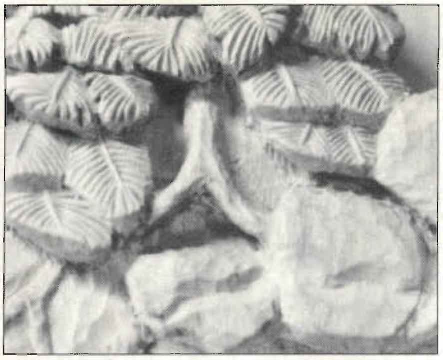


Carve the vertical lines of the tree bark using a U–tool.

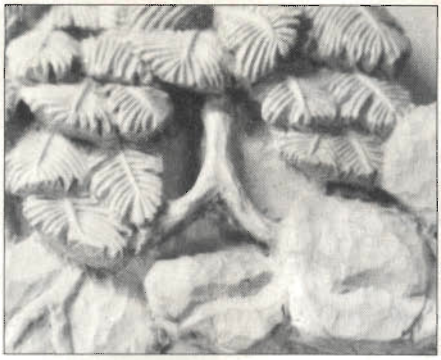


Make the random cross cuts with the same tool.





Define the needles with a sharp V–tool.



Finally, undercut and make the edges irregular.

photos and illustrations by the author

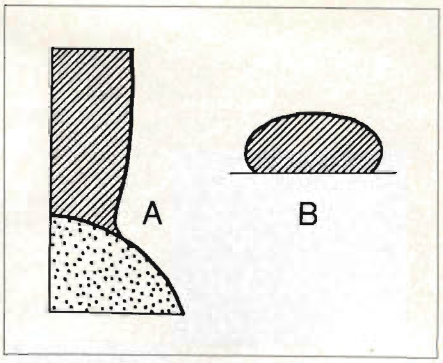


Figure 1. *Cross–sectional views of a tree trunk*

tical to represent the circular circumference. Also, even though the tree trunks may be straight vertically, they cannot be carved that way since, as we learned from our discussion of direct depth perspective, straight lines in nature are convex when represented in the third dimension of a carving. The applications of these techniques to provide the correct illusion are shown in Figure 1. In view A, the side view, notice the two convex surfaces, one representing the vertical edge of the tree and the other the almost horizontal lawn. At the base of a tree there is usually a flare out for the roots. This is indicated in the carving by the concave flare at the base of the tree. In view B you can see the elliptical shape of the tree trunk in a down view cross section.

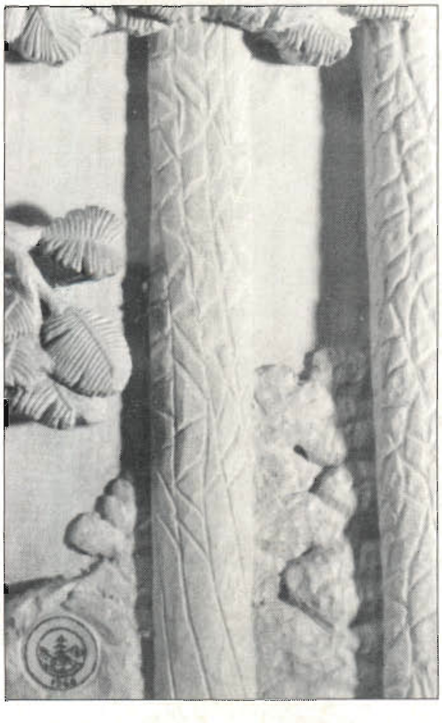
To carve the bark on the tree trunks you must first analyze their form. The approach is shown in Figure 2. The first sketch shows how the analysis leads us to see a series of vertical lines. Then in the second sketch I have put in the cross lines which define the individual pieces of bark. This, then, is the two-step process used to carve the bark. The carving process is illustrated in the next set of photographs.

The first photograph shows the vertical lines which have been put in using a 3mm U–tool. In the next picture the cross cuts are carved using the same tool. Following this, I used a 4mm #3 gouge to round the sharp edges from these U-cuts as shown in the third photograph. They were further smoothed using a coarse diamond riffler file. Sandpaper could have been used, but for this type of shaping I prefer to use rifflers. The final carving step is to texture the surface of the bark with the 4mm #3 gouge and remove any regularities. The final texturing step is to rough up the surface with a steel brush, followed with a brass brush which is somewhat softer. These brushes act similarly to very coarse sandpaper but do not tend to smooth the surface or change its shape. The final result is shown in the last photograph.

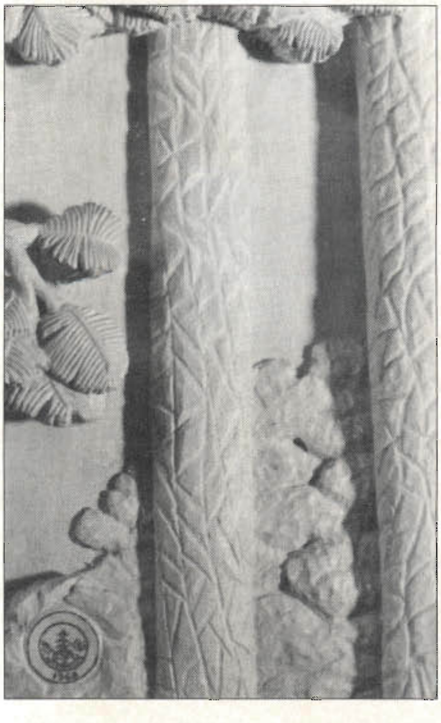
Carving the Bushes

When carving the leaves of bushes, you must develop a pattern of some sort. Random cuts to merely create texture seldom make convincing foliage. You must look for patterns in nature and then apply them to your design. You will notice that the leaves appear in clusters. This is due to the branching

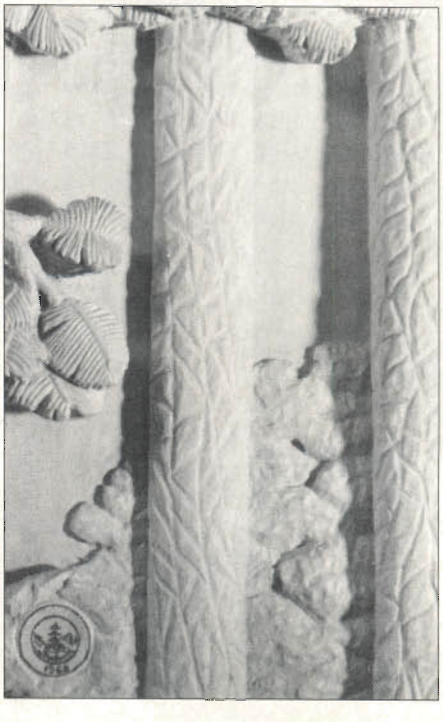
Round the sharp edges of the cuts.

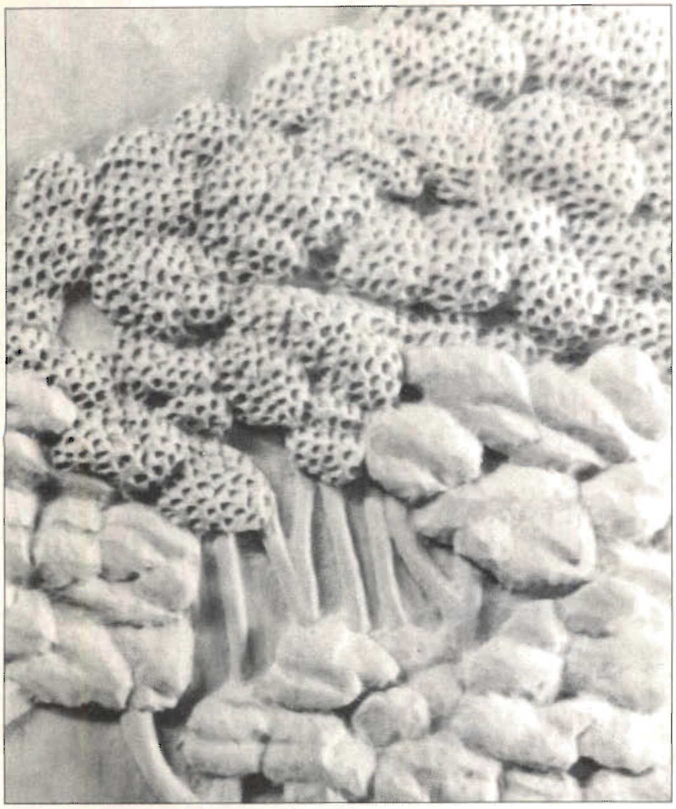


Smooth and shape the surface further with a riffler file.

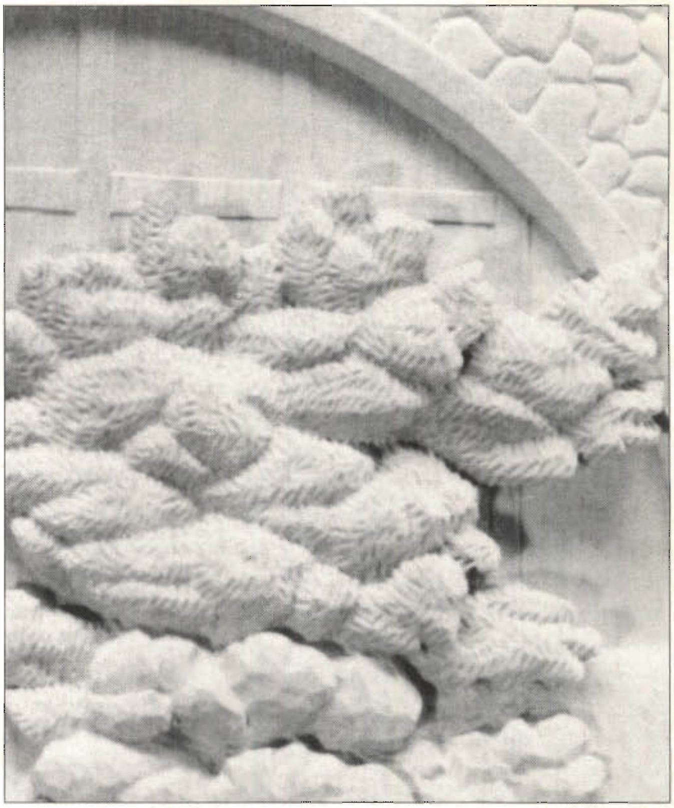


Go back with a gouge to take out any regularities, and use steel and brass brushes to complete the texturing.





To give the impression of manzanita foliage, the author carved deep holes to simulate the light and shadow pattern of the leaves.



Since shrubbery that is further away would appear less well–defined, the author used a brass brush to soften the texture.

structure of the bush. Study bushes to find these clusters, and put them into your carving. They will be indicated by the shadows they cast. These clusters should be the first form you carve before doing the detailing to represent the leaves. One warning: make sure your patterns of branches do not form a shape that can be recognized as a familiar object. If the eye–brain combination can make such an interpretation, *it will.* This disrupts the appearance of your carving since the observer will be unable to shake this unintended figure.

When I studied the manzanita bush on the right side of the carving near the picnic bench, the leaves suggested deep holes to me. I arranged them in clusters, with open areas in between where the branches could be seen – especially near the ground. These holes were carved in the wood using a 2mm U–tool – again of Japanese make because of the thin blades. I held the tool at a high angle to the wood and rotated it to make a circular hole. These holes would cast dark shadows which would give the effect I desired. This is in contrast to the more distant bushes which were textured with longer and shallower cuts with the U-tool. The far bushes near the building were further softened by again using a brass brush.

Texturing the Grass

In this scene there is a small section of grass in the lower left corner of the panel where the girl is sitting and a much larger region on the far shore of the lake. I used two different techniques in carving the two areas. The optical principle to keep in mind is that sharp, clean edges tend to advance, while soft edges tend to recede.

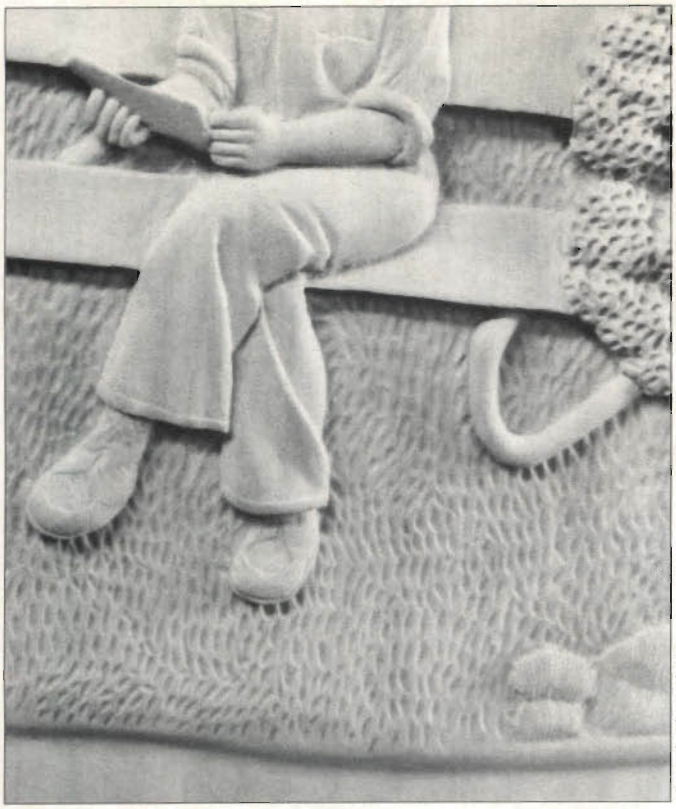
Since the grass on the far shore should be less well–defined, I carved it with a bull-nosed U–tool. The U–tool was sharpened into a bull–nose shape to facilitate the short scoop–like cuts used to texture the surface. This is one of the few times you will want a gouge shaped this way. I also used a brass brush to further soften the cuts on the far shore. The near–shore grass was done with a sharp–edged V–tool.

I did the texturing on the far shore in short sections following the arc of a circle and trying not to create a repetitive pattern that could be picked up by the eye. Such patterns would detract from the carving. Also in this texturing I used the principle of **tonal contrast** to further increase the illusion of distance. The cuts made in the back of the scene were smaller and closer together than those near the shore of the lake.

The Stone Wall

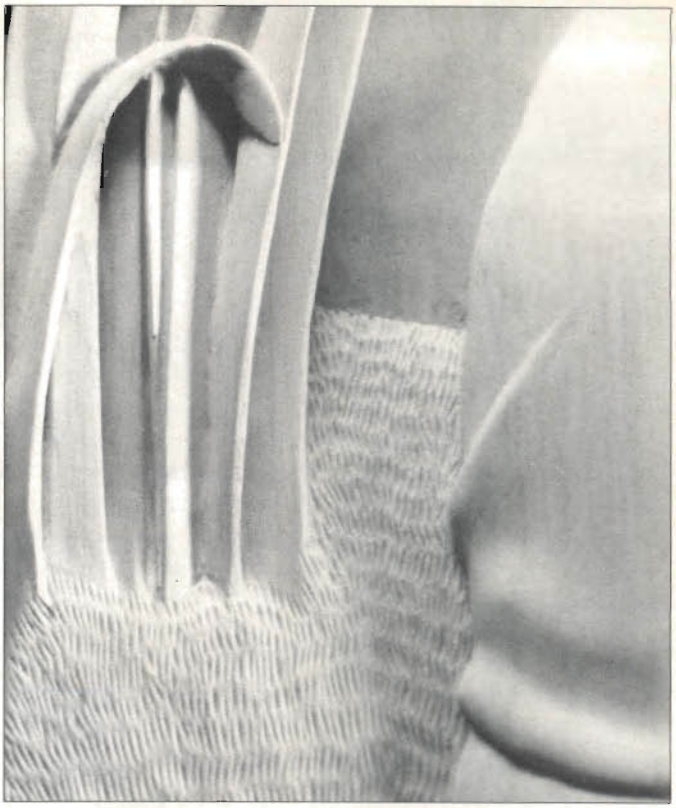
The bottom right photo shows the steps to carve the masonry on the wall of the building. The procedures are illustrated from right to left in the picture. On the far right you can see the smoothed surface which is the starting point for all texturing. Next the lines separating the stones are sketched in with pencil and outlined with the V-tool. The texturing then proceeds in a manner similar to that used for the bark on the trees. Shaping with a #3 gouge, removing rough edges with diamond rifflers, texturing with the #3 gouge, and a final smoothing with steel and brass brushes.

In this series on relief carving I have illustrated the carving techniques using the Columbia Panel as an example. The finished carving now hangs in their library, and readers are invited to visit the college to see this and other fine relief carvings in their collection. Columbia College is located in the foothills of the picturesque Sierra Nevada between Sonora and Columbia State Park. PW



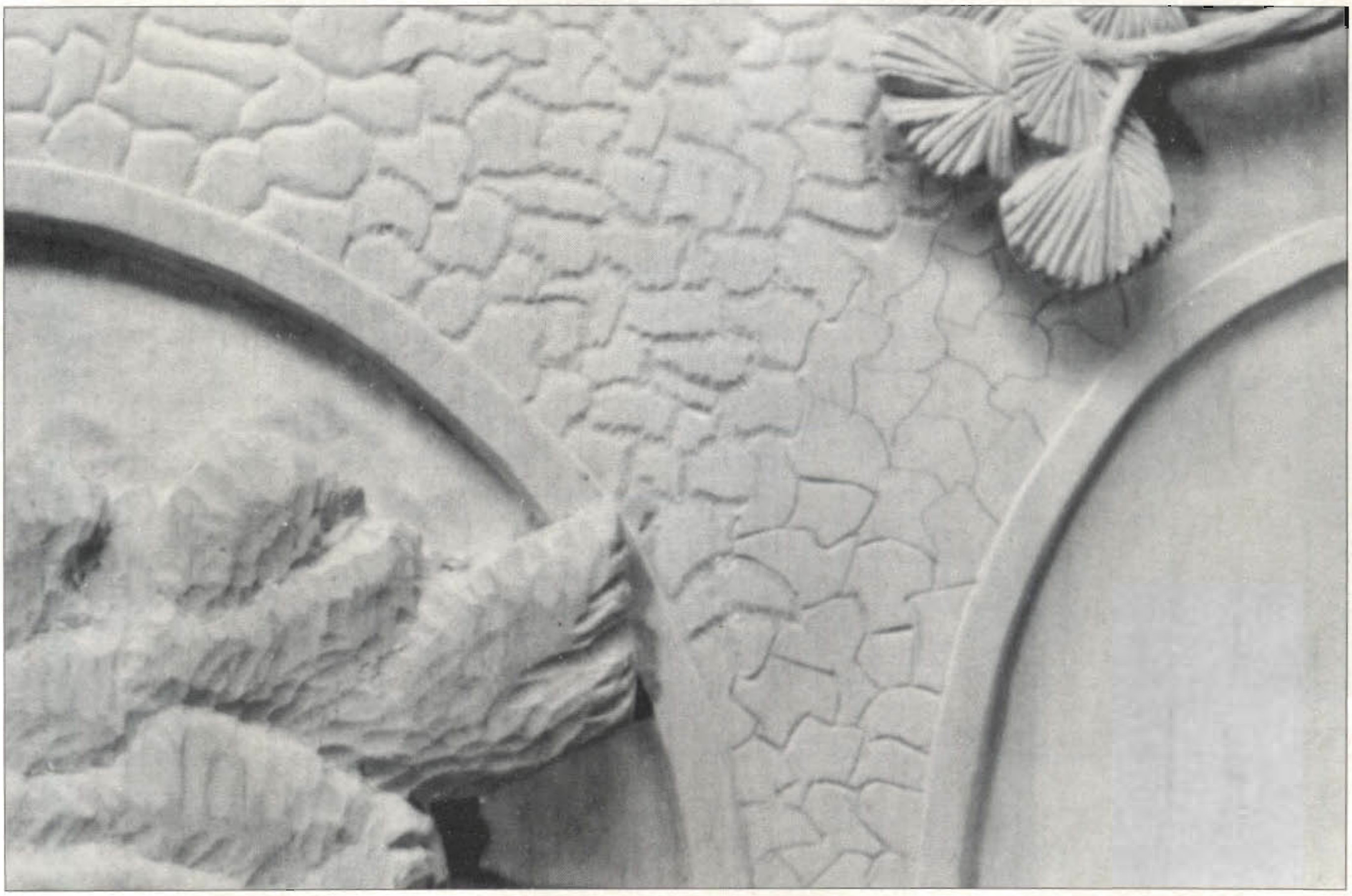
photos by the author

The grass on the far shore was carved in short, scoop–like cuts with a bull–nosed U–tool and softened with a brass brush.



On the near shore the grass is more sharply defined by using a V–tool and longer, thinner cuts.

To carve a stone wall, pencil the shapes of the stones on a smooth surface, outline them with a V–tool, then shape and texture with the gouge, rifflers, and brushes in much the same way as the tree bark.



Tests & Comments

by Hugh Foster

Shop Software

Plywood Planner is a computer program created by Roger & Ryan Drummond that will help you find the best way to lay out your project on plywood, metal, plastic laminates, or other sheet stock. The software is designed for IBM & compatibles with color graphics adapter or Hercules graphics card and 128K RAM, DOS 2.0 or higher and Commodore 64, Apple $24.95.

Being a typical computer operator, the first thing I did with this disk was to try to run it without reading the directions. I was rewarded with an error message. Frustrated because most computer instructions are simply awful, I sat back, gritted my teeth, and read the directions. What a surprise!

There are two sets of directions, one in a disk file, the other: a 17–page users' manual. The on–screen document files are a model of their kind. The Drummonds have refined their program, making it very simple, and unlike many software authors, they have attended to writing clear documentation. I thought the manual might be superfluous, but many of the niceties of the program are thoroughly explained there. Read the manual; you'll be glad you did!

The program would be valuable to people who deal with wood via computer if only for its on–screen decimal equivalent chart.

To use it, you enter the sizes of the pieces you wish to cut. Be sure to enter these sizes by length, then width, for the program will assume that that's the way you want the grain to run; it won't turn pieces to make them fit (but wouldn't a particle–board option be nice on a future version?). I thought I was "faking out" the program when I entered 127.224% of a sheet; one of the pieces I hoped to cut was 101"×6". Gleefully, I watched the program accept my input; then I was even more delighted as the computer drew on the screen as much it could fit into the sheet and presented me with a list of pieces that wouldn't fit.

A sample of this program's printout (reduced here from its 6 × 8 actual size) is reproduced below.

This software is available from Coiner Computer Systems, Landmark Pavilion, #7, 150 Robbins Station Rd., North Huntingdon, PA 15642.

The program doesn't do anything besides lay out plywood, but the first mistake it prevents will pay for itself, especially now that hardwood plywoods cost several dollars per square foot. I wouldn't be without it if I used more than three or four sheets of plywood per year. It sure is handier to go at the sheet of plywood with a list and a chart than with a pencil and a question. In fact, in a $20/hour shop, the first complex layout might pay for the program. What better recommendation could I give? **PW**

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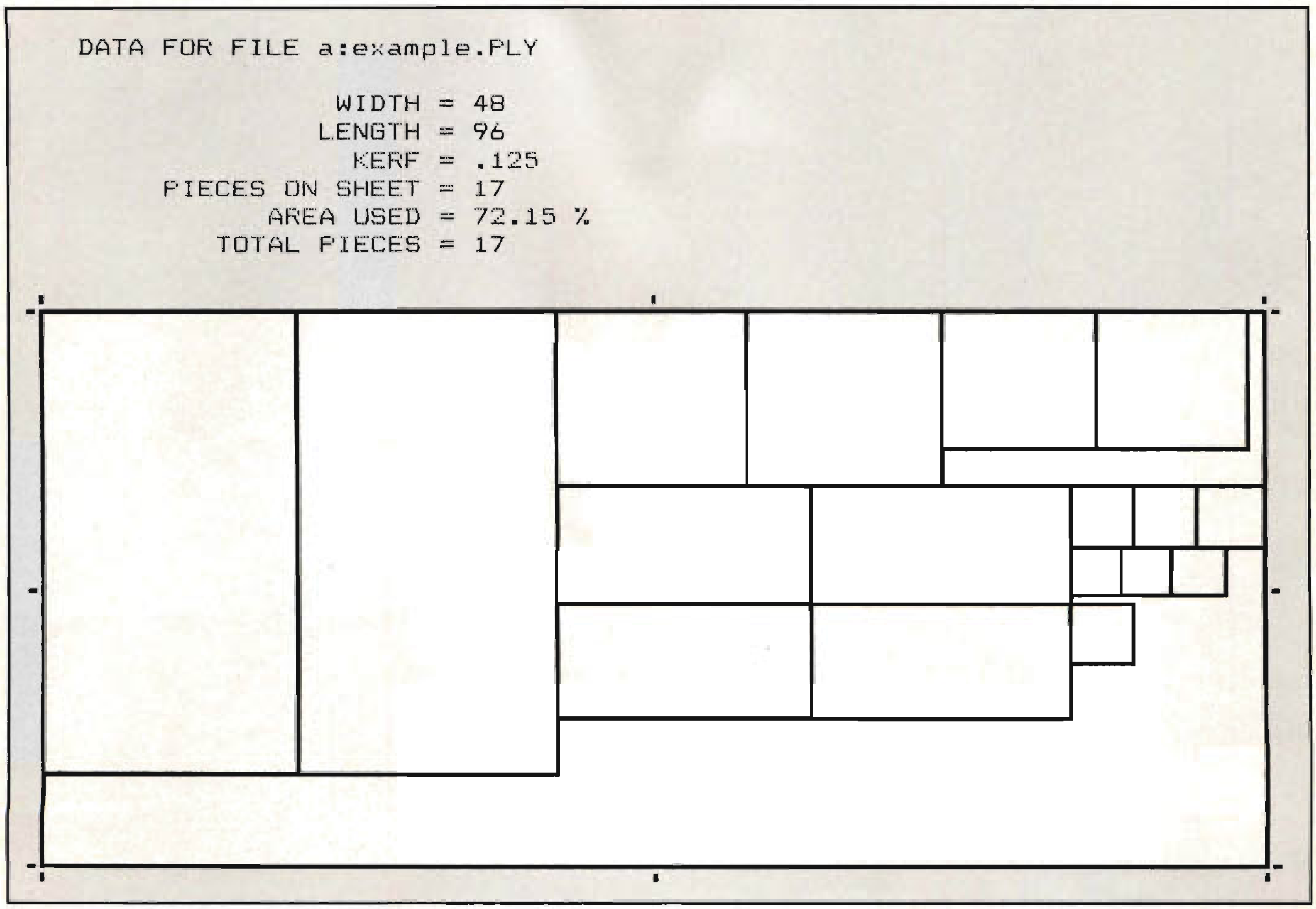
*When he's not pursuing freelance writing or teaching English, **Hugh Foster** designs and builds custom furniture in Manitowoc, Wisconsin.*



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               LENGTH = 96
                 KERF = .125
      PIECES ON SHEET = 17
            AREA USED = 72.15 %
         TOTAL PIECES = 17
```

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The Business End

by Peter Good

Earning for the Future

In woodworking, as in many craft businesses, poverty is often the result of a game that is played by the woodworker and the customer. The rules of the game are simple – the customer shops around and hires the hungriest woodworker. All the woodworkers cut their prices in an attempt to be the hungriest to get the work, but at such a small profit that it insures that they will stay hungry. Playing the same old game may keep your financial head above water, but it may not provide anything for your future. If you're self–employed, paying for your future is your own responsibility, and it may be a good idea to start now.

Let's talk about planning and paying for retirement, the kid's education, illness and dying. Now, I know you don't want to talk about these things, but we're going to talk about them anyway. If you've already made full provision for all these things, congratulations for your foresight and planning. You may stop here and turn the page. The rest of you keep reading.

As the owner of Grand Openings in Oakland, California, ***Peter Good*** *manufactures doors. He also gives seminars at national woodworking shows on the business aspects of running a small shop.*

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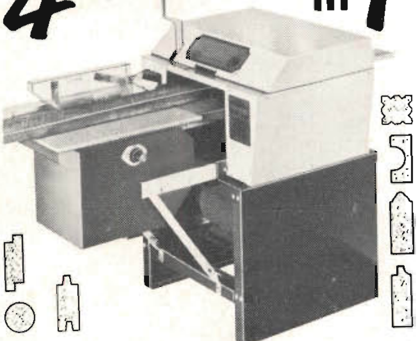

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To start off with, let's add up a few numbers and get an idea of what kind of money we're talking about. The assumptions for this discussion will be that you're self–employed, married, have 2 kids, would like to retire at 65, and (please excuse my bluntness) will die at 85.

For the kid's education, we'll make it easy. Let's say they both go to a state-supported four-year college. That's going to run you at least $6,000 per year, per kid, for tuition or fees, books, room, and board. Total bill for 2 kids: $48,000. How about illness after you retire? The kids are on their own, and it's just you and your spouse. If you have a pretty complete health insurance plan for 2 people, it will probably run around $200 per month. Over the 20 years of your retirement that will come to a total of, you guessed it, another $48,000. How about dying? Well, that will vary depending on where you decide to do it and in what style you'd like to be laid to rest. Let's say it will run you ten grand. So far, we're up to a total of $106,000 and we haven't even touched the subject of living expenses (other than medical) during retirement. You may say, "I'm not going to retire. I'm going to work until I drop, even if it's just to avoid boredom!" Guess again. Things change and you may find after awhile that you *have* to retire because you are no longer able, for whatever reason, to continue working. You may develop physical disabilities or substance allergies that restrict or force you to stop working.

For the purpose of figuring retirement income needs, let's say that you and your spouse need a minimum of $40,000 per year to cover food, clothing, rent or mortgage, car or transportation expenses, housekeeping expenses, modest entertainment, utilities and services, taxes, insurance, and a bit of travel. That comes to a whopping $800,000 over 20 years. So, altogether, we're now up to a total of $906,000 worth of unpleasant costs that you may not have thought of. True, social security *may* pay for some of this, but how much? Given the current state of the social security system, maybe you shouldn't count on it.

Now, let's say that you're 45 years old. That means you have 20 years before you retire to get this $906,000. I'll save you the trouble of figuring it out. It comes to $45,300 per year that you have to start making *now*, for the future. If you're only 35 years old, it's $30,200 per year. If you're 25, it's $22,650. And if you're 55 years old, you're in trouble; it's $90,600 per year you have to come up with, over and above whatever your current living expenses are. Gloomy, isn't it?

There is no easy solution to all of this unless you happen to win a lottery or come into a healthy inheritance. Otherwise, it will take some financial planning, most of which I can't help you with. One thing that *will* help ease the burden is to understand that it's essential to figure these future costs into the prices you're charging today. Every job you do should include its fair share of financial compensation to pay for your personal future costs.

It's necessary for each woodworker to insure that his or her level of quality and service are high, then resolve to charge realistically higher prices and avoid being in the position of the hungriest woodworker. The woodworker has chosen to be self–employed in a field which is either labor–intensive on a small–scale, individualized level, or very competitive with high overhead on a larger scale, production level. On the production level, everybody tries to copy everybody else and each ends up with a share of the pie. The business that gets a larger share of the pie is the one that is able to develop sufficiently different techniques or cater to a sufficiently different market to pull ahead of the competitors. In a small–scale, individualized operation, the trick is to develop a level of quality and service that is high enough to command a higher price.

In either large or small–scale operations, it's important to take some time to isolate the problems and formulate a plan, with a timetable, to transform the business into one that will produce not only enough income to take care of current operating costs plus profit, but also methodically pay for your future. **PW**

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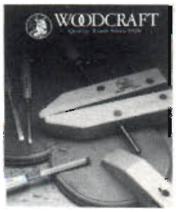

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Calendar

Events of Interest to Woodworkers

April/May, Brookfield, CT

Brookfield Craft Center announces their Spring 1988 curriculum of innovative arts/craft classes and workshops. A free 32–page course catalog is available by calling 203-775-4526 or 203-853-6155 or by writing Brookfield Craft Center at P.O. Box 122, Brookfield, CT 06804.

April 7-May 1, Vashon, WA

"Animal Influences," an exhibit of the unique furniture of Steven Caldwell. For more information contact Cheryl Peterson, Northwest Gallery of Fine Woodworking, 202 First Avenue South, Seattle, WA 98104 or call (206) 625-0542.

April 8-20, College Park, GA

The Atlanta Woodworking Show will feature machinery, power and hand tools, supplies, demonstrations, seminars, free workshops and more. Georgia International Trade Center, Hall B, 1902 Sullivan Rd. For more information contact (213) 477-8521 (in California) or 1-800-826-8257.

April 14-22 Baltimore, MD

The American Craft Showroom will be open for National Furniture Market. For more information contact Buyers Market of American Crafts, Suite 300 Mill Centre, 3000 Chestnut Ave., Baltimore, MD 21211 or call (301) 889-2933.

April 15-17, Gaithersburg, MD

13th Annual Spring Arts & Crafts Fair at the Montgomery County Fairgrounds, featuring 350 professional artists and craftspeople. For more information contact Deann Verdier, Director, Sugarloaf Mountain Works, Inc., 20251 Century Blvd., Germantown, MD 20874 or call (301) 540-0900.

April 22-24, Washington, D.C.

The Washington Craft Show is one of the most prestigious juried shows of crafts as fine art in the country. It's held at the Departmental Auditorium, 1301 Constitution Ave., NW, Washington, D.C. 20036. For more information contact Smithsonian Visitor Information and Associates' Reception Center, Arts & Industries Bldg., Room 1465, Smithsonian Institution, Washington, D.C., 20560 or call (202) 357-4000.

April 29-May 1, Los Angeles, CA

The Southern California Woodworking Show will feature machinery, power and hand tools, supplies, demonstrations, seminars, free workshops and more. Los Angeles Airport Hilton, Pavilion, 5711 West Century Blvd., Los Angeles, CA 90045-5631. For more information contact (213) 477-8521 (in California) or 1-800-826-8257.

April 29-May 1, Boston, MA

Woodworking World - The Boston Show, Bayside Expo Center. Within 100–mile radius of Hartford, CT; Concord, NH; Brattleboro, VT and all parts of Rhode Island. For more information call Christine Murphy (603) 536-3768.

April 29-30, May 1, Timonium, MD

11th Annual Spring Crafts Festival at the Maryland State Fairgrounds, featuring 250 professional artists and craftspeople. For detailed information contact Deann Verdier, Director, Sugarloaf Mountain Works, Inc., 20251 Cen-

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tury Blvd., Germantown, MD 20874 or call (301) 540-0900.

April 29-May 1, Boston, MA

The Woodworking Association of North America (W.A.N.A.) presents the 6th Annual Boston Show at Bayside Expo Center, Boston, MA. For more information call 1-800-521-7623.

May 5-28, Seattle, WA

"Chairs" is a gathering of NW style seating by local designer/craftsmen. For more information contact Cheryl Peterson, Northwest Gallery of Fine Woodworking, 202 First Avenue South, Seattle, WA 98104 or call (206) 625-0542.

May 6-8, Dallas, TX

The North Texas Woodworking Show will feature machinery, power and hand tools, supplies, demonstrations, seminars, free workshops and more, at the Dallas Convention Center, North Hall, 650 South Griffin St. For more information contact (213) 477-8521 (in California) or 1-800-8257.

May 7, San Francisco, CA

"Health Hazards in Arts and Crafts" is a one–day conference designed to benefit anyone concerned with the arts or health and safety issues. For further information, call The American Lung Association of San Francisco (415) 543-4410.

May 9-13, Toledo, OH

A Spray Finishing Technology Workshop will be held by Bowling Green State University and the DeVilbiss Co. Workshop sessions will be held at the Technical Training Center of the DeVilbiss Co., World Headquarters, Toledo. For more information contact the College of Technology, Bowling Green State University, Bowling Green, OH 43403 or call Judy Jennings (419) 372-2439.

May 13-15, St. Charles, IL

The Chicagoland Woodworking Show will feature machinery, power and hand tools, supplies, demonstrations, seminars, free workshops and more at the Pheasant Run Exhibit Center, "Mega–Center," Route 64, St. Charles IL 60174. For more information contact (213) 477-8521 (in California) or 1-800-826-8257.

May 20-22, Rochester, NY

The Upstate New York Woodworking Show will feature machinery, power and hand tools, supplies, demonstration, seminars, free workshops and more at the Riverside Convention Center, South Hall, 123 East Main St. For more information contact (213) 477-8521 (in California) or 1-800-826-8257.

June 6-10 & 13-17, Gatlinburg, TN

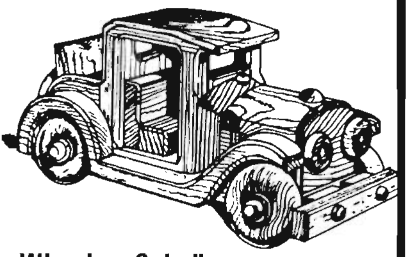
Liam O'Neill - Woodturning Course - Functional and Artistic: Beginning to Advanced. Emphasis on skills necessary to produce functional and one-of-a-kind pieces. For more information contact Cynthia Huff, Arrowmont School of Arts and Crafts, Box 567, Gatlinburg, TN 37738 or call (615) 436-5860.

June, Richmond, VA

Exhibition notice: The Richmond Craft Show will be held November 19, 20, and 22, 1988 at the new Richmond Centre for Conventions and Exhibitions in downtown Richmond, VA. 175 exhibitors will be accepted by a slide jury in early June. Notification is by mid-July. For further information or for application forms, call or write to Linda Smalley, Project Coordinator, Hand Workshop, 1812 West Main St., Richmond, VA 23220, (804) 353-0094.

Summer Workshops, Portland, OR

The Oregon School of Arts and Crafts announces Summer Workshops for 1988. Workshop registrations are taken on a first-come basis, and close one week prior to the first day of class. Call (503) 297-5544 or write the school for a Summer Schedule. June 20-24, Furniture Design: Seth Stem. July 7-10, Furniture Design: Techniques and Construction - Tage Frid. July 8, Tage Frid Lecture.



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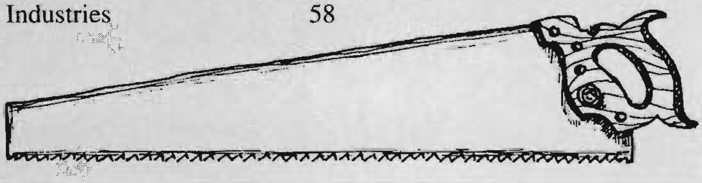

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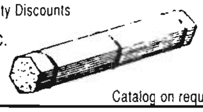

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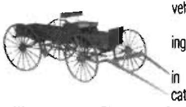

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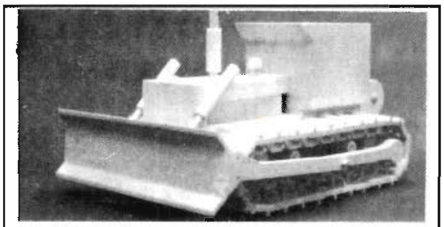

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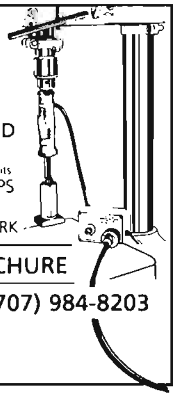

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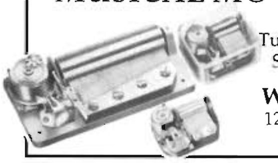

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Out of the Woodwork

by Susan E. Shakespeare

Building a Stairway

Building a stairway may, at first, seem like an extremely simple project, but there are a few things to take into consideration before beginning.

First, it is of primary importance to examine the desired location to see if there is, indeed, a source of elevation. Stairs simply do not pan out on a single level. You may think I'm nit-picking here, but I assure you, a change in level from one end to the other end is essential to the very nature of stairs.

It is not terribly hard to determine if, in fact, a change of level exists at your proposed construction site. Technical terms may at first discourage you, but you will find it completely unnecessary to call in a construction expert for determining level change if you follow these few simple instructions.

To begin with, stand in the spot where, had you already built the stairs in question, the bottom of the flight would be. Next, look to where you would expect the top of that same flight to be when finished. If you found yourself tilting your head in an upward motion, you're in luck - stairs are an appropriate project for that site. If your head did not follow an upward pattern of movement, you may be confusing a need for a flight of stairs with the need for a floor.

Also when building a stairway, it is an excellent idea to make very sure that you have first provided a hole at the top and again at the bottom of the stairs. This will become important when actually using the stairway. It is possible, once you begin, to create these entrances and exits; but it is essential that there be an opening at one end or the other to provide a place from which to begin.

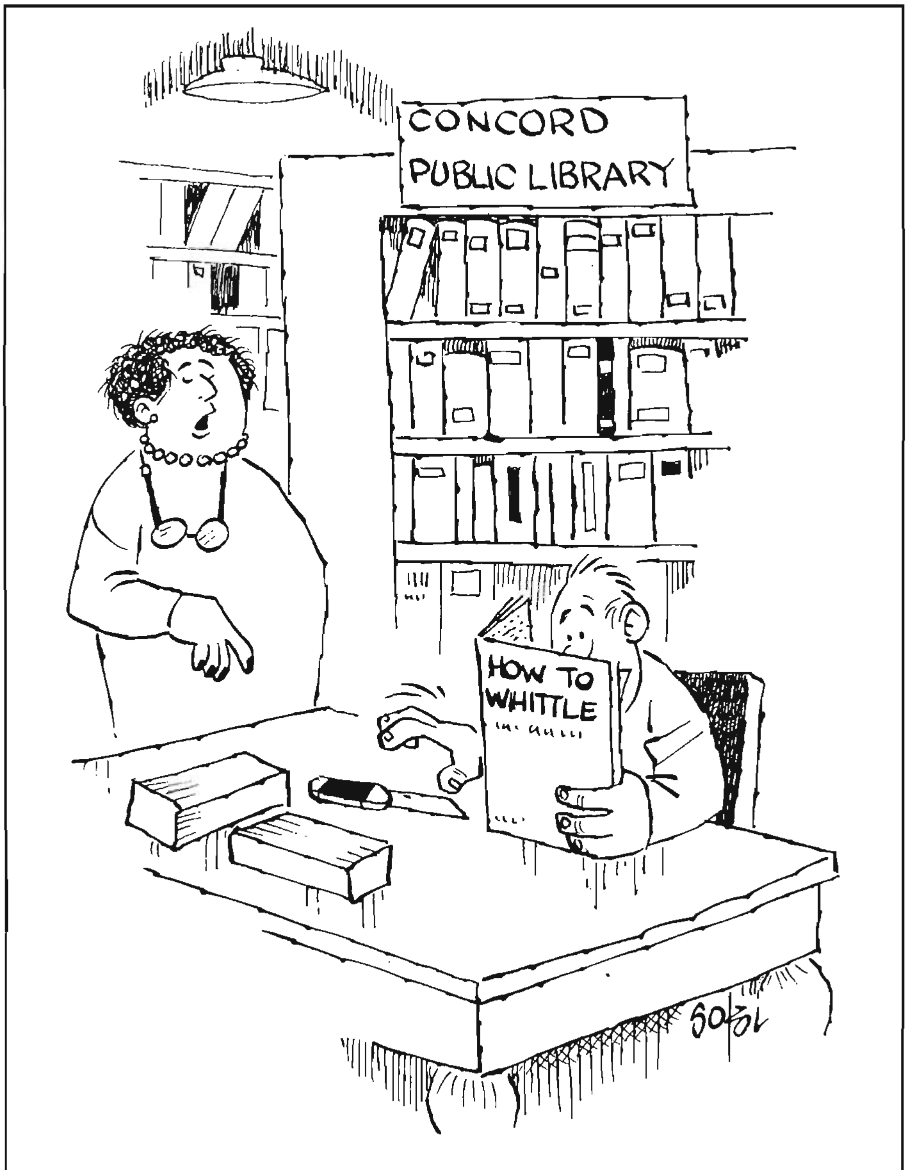
Once a point of departure has been established, the actual building may commence.

If stairs are meant as a functional addition to your home, it is necessary to remember that one step must be either higher or lower than the one before it. This becomes important when one wishes to advance, either upward or downward, when using the stairs. It is also very important to remember that once you have decided to make a step higher or lower than the previous one, you must establish a pattern in regard to the next step, the one after that, and so on. Failure to adhere to an established pattern may result in an up, down, up, down type of movement that would result in placing you more or less in the same place you began, but a little further along.

The materials for building your flight of stairs are a matter of preference; but I have always found that straight, flat objects upon which one may step, joined by common nails or perhaps some glue, is about all that is needed. It is also very helpful to have something with which to drive the nails into the straight, flat objects. A hammer does nicely here. However, if you're feeling creative, any number of objects may be substituted, provided, of course, that you may safely whack it against a nail and expect it to drive the nail in.

One last note: After the actual construction of the stairs, you may wish to be assured of their safety. This is completely understandable and quite commendable. However, it is recommended that you enlist the help of unpopular family members to determine whether or not your stairway is safe. After all, if repairs are necessary, you want to be in good health to handle them. PW

Susan E. Shakespeare is an antique refinisher and writer in Pittsburgh, PA.



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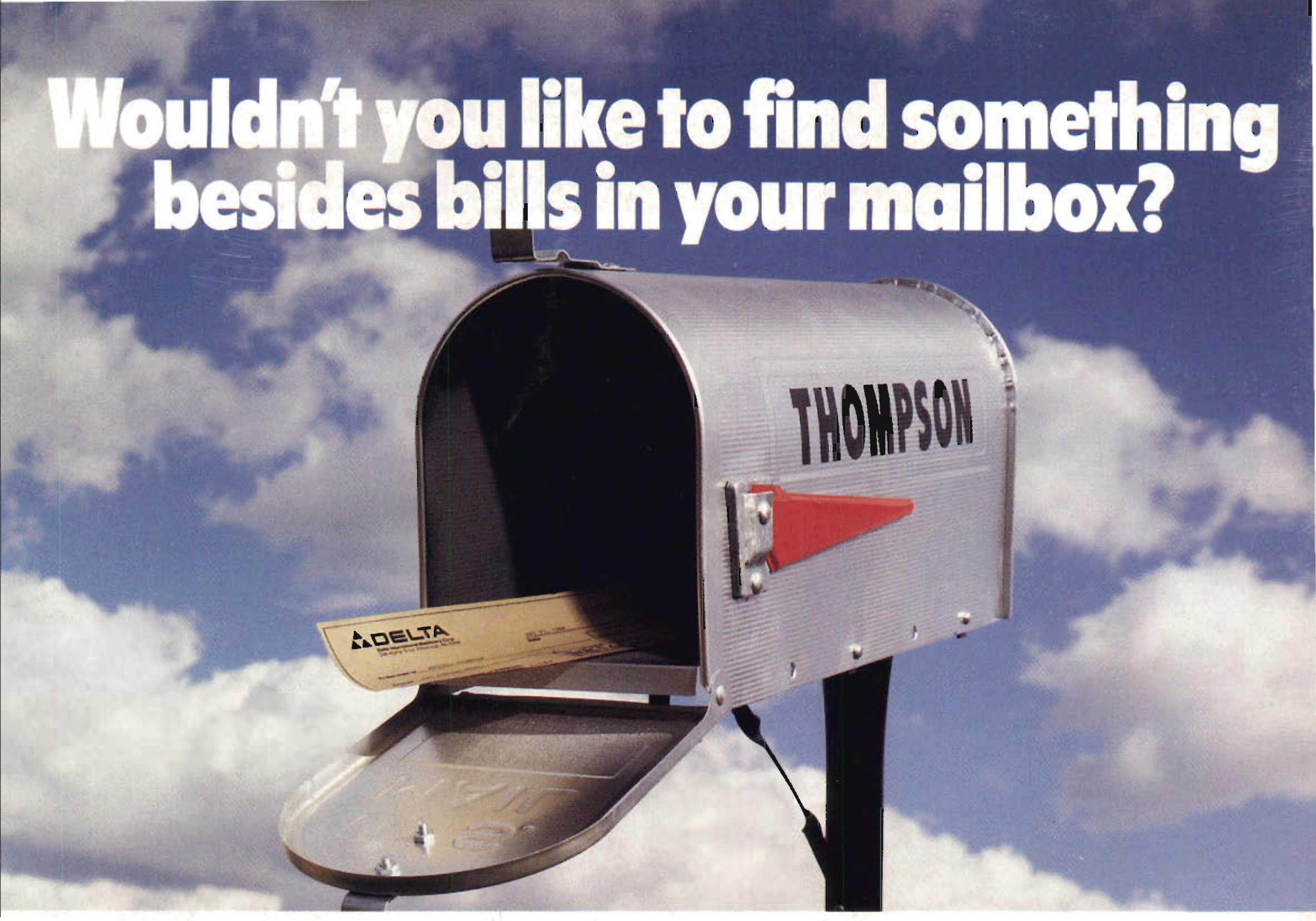

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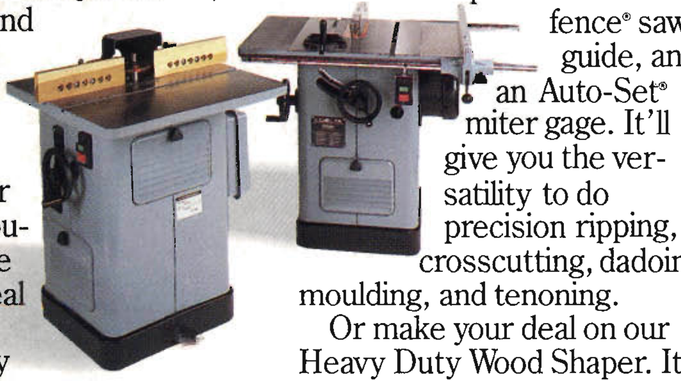

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